SCIENTIFIC AMERICAN

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HUGE UNLOADERS FOR TRANSFERRING COAL BETWEEN SHIPS AND CARS—[See page 104]

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Bristol to Port Darwin

How engine results have built up America's supremacy in Scientific Lubrication

A LEADING British manufacturer of airplanes recently was arranging the details of a proposed flight from Bristol, England, to Port Darwin, Australia. Supplies of fuel were essential. Correct lubrication was vital.

Remembering the supremacy of Gargoyle Mobiloils in Scientific Lubrication, he sent to the Vacuum Oil Company's nearest office this list of the cities where he would require oil:

Bristol, England; Lyons, France: Florence, Italy; Salonica, Greece; Constantinople, Turkey; Sivas, Bahahan, Persia; Karachi, Bunder Abbas, Delhi, and Calcutta, India; Rangoon, Burma; Batavia, [illegible]nen and Enden, East Indies; Port [illegible]n, Australia.

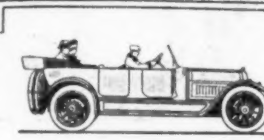
At every one of these points, or close at hand, Gargoyle Mobiloils were obtainable.

Gargoyle Mobiloils have established America's supremacy in the Scientific Lubrication of all automotive equipment because of *engine results.*

The further a motorist is from expert service, the more careful he must be to secure *engine results.*

Gargoyle Mobiloils when used as specified in the Chart give full protection to all frictional surfaces. They increase gasoline mileage, insure full power and last longer than other oils.

If you feel that the time has come to get better *engine results* from *your own automobile,* we suggest that you consult the Chart at the right.



Correct
AUTOMOBILE LUBRICATION

GARGOYLE
Mobiloils
A grade for each type of motor

Gargoyle Mobiloils for engine lubrication are:

Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
Gargoyle Mobiloil "E"
Gargoyle Mobiloil Arctic

The Chart below indicates the grade recommended by the Vacuum Oil Company's Board of Engineers. The recommendations cover all models of both passenger and commercial vehicles unless otherwise noted. If your car is not listed in this partial Chart, send for booklet "Correct Lubrication" which lists the correct grades for *all* cars.

AUTOMOBILES	[illegible]		[illegible]		1917		[illegible]		[illegible]	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Allen	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Auburn (4 cyl.)							A	Arc	A	Arc
Auburn (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Auburn (6-38)					A	Arc	A	Arc		
" (6-39B) (Teetor-H)			A	Arc						
Autocar (2 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Briscoe	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)							A	A		
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cadillac (8 cyl.)	A	A	A	A	A	A	A	A	Arc	Arc
Case	Arc	Arc	Arc	Arc	A	Arc	A	Arc	A	Arc
Chalmers			A	A			Arc	Arc	Arc	Arc
" (6-40)							A	Arc		
" (6-30)	A	A			A	A	A	A		
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)	A	A	A	A	A	A				
" (F.A.)	A	Arc	A	Arc						
Cole							Arc	Arc	Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A	A	A
Cunningham									Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A		
Dart	Arc	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
" (Model C)					A	Arc	A	Arc	A	Arc
" (2 and 3½ ton)	A	A	A	A						
Dodge Brothers	A	Arc	A	Arc	A	Arc	A	Arc	E	E
Dort	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Federal	Arc	Arc	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" (Mod. S-X)			A	A	A	A				
Federal (special)			Arc	Arc						
Fiat			B	A	B	A	B	A	B	A
Ford	E	E	E	E	E	E	E	E	E	E
Franklin	A	A	A	A	A	A	A	A	A	A
Grant	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
" Com'l	Arc	Arc								
" " (Model 12)	A	Arc								
Haynes	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (12 cyl.)	A	A	A	A	A	A	A	A		
Hudson							Arc	Arc	Arc	Arc
" Super Six	A	Arc	A	Arc	A	Arc	A	A		
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Kelly Springfield	A	A	A	A	A	A	A	A	A	A
King									A	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A	Arc	Arc
" Commercial			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Kissel Kar	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" " (Model 48)							A	A	A	A
" " (12 cyl.)			A	A	A	A				
Lexington	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Lippard Stewart			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" " (Mod. M)					A	Arc	A	Arc		
" " (Mod. MW)					A	Arc				
Locomobile	A	E	A	E	E	E	E	E	E	E
McFarlan			A	Arc	A	Arc	A	A	A	Arc
McLaughlin	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
McLaughlin (Mod. E63)	A	A	A	A						
Madison			A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)					A	A	A	A		
Marmon	A	A	A	A	A	A	A	A	A	Arc
Maxwell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer	A	A	A	A	A	A	A	A	A	Arc
" (22-70)									Arc	Arc
Mitchell	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)							A	A		
Moline-Knight	B	A	B	A	A	A	A	A	A	A
Monroe			A	Arc	A	Arc	E	E	A	Arc
" (Mod. M4)			A	A	A	A				
" (Mod. 5)	A	A								
Moon			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Nash	A	Arc	A	Arc						
" (Mod. 671)			A	A						
" (Quad)	A	A	A	A						
National	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
" (12 cyl.)	A	A	A	A	A	A	A	A		
Nelson	A	A	A	A	A	A				
Oakland	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)							A	A		
Oldsmobile (4 cyl.)	A	Arc					Arc	Arc	Arc	Arc
" (6 cyl.)	A	A	A	A	Arc	Arc			Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A		
Overland	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Packard									A	Arc
" (12 cyl.)	A	A	A	A	A	A	A	A		
" Commercial	A	A	A	A	A	A	A	A	A	A
Paige (4 cyl.)									A	Arc
" (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (6-36)							A	Arc	A	Arc
" (6-38-39)					A	Arc				
" (6-40)	A	Arc	A	Arc						
Paige (Com'l)	Arc	Arc	Arc	Arc						
Paterson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Peerless			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A		
Pierce Arrow	A	A	A	A	A	A	A	A	Arc	Arc
" " Com'l	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	A	A	A	A	Arc	A	Arc
Regal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)							A	A	Arc	Arc
Renault (French)							A	Arc	A	Arc
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Riker	A	E	A	E	E	E				
Saxon	E	E	E	E	E	E	E	E	E	E
Selden	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (3½ ton)					A	Arc				
Simplex Crane			A	A	A	A	A	A	Arc	Arc
Stearns-Knight	B	A	B	A	A	A	B	A	B	A
Studebaker	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
Stutz	A	A	A	A	A	A	A	A	A	A
Velie (4 cyl.)									A	Arc
" (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (2 & 3½ ton)	Arc	Arc	Arc	Arc						
" (3½ ton)	A	Arc	A	Arc						
Westcott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Sixteen Valve)	A	A	A	A	A	A				
White (3 ton)	A	A	Arc	Arc						
Willys-Knight	B	A	B	A	A	A	B	A	B	A
Willys Six	Arc	Arc	Arc	Arc	Arc	Arc				
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc


FEDERAL

SEVENTY-SIXTH YEAR

SCIENTIFIC AMERICAN

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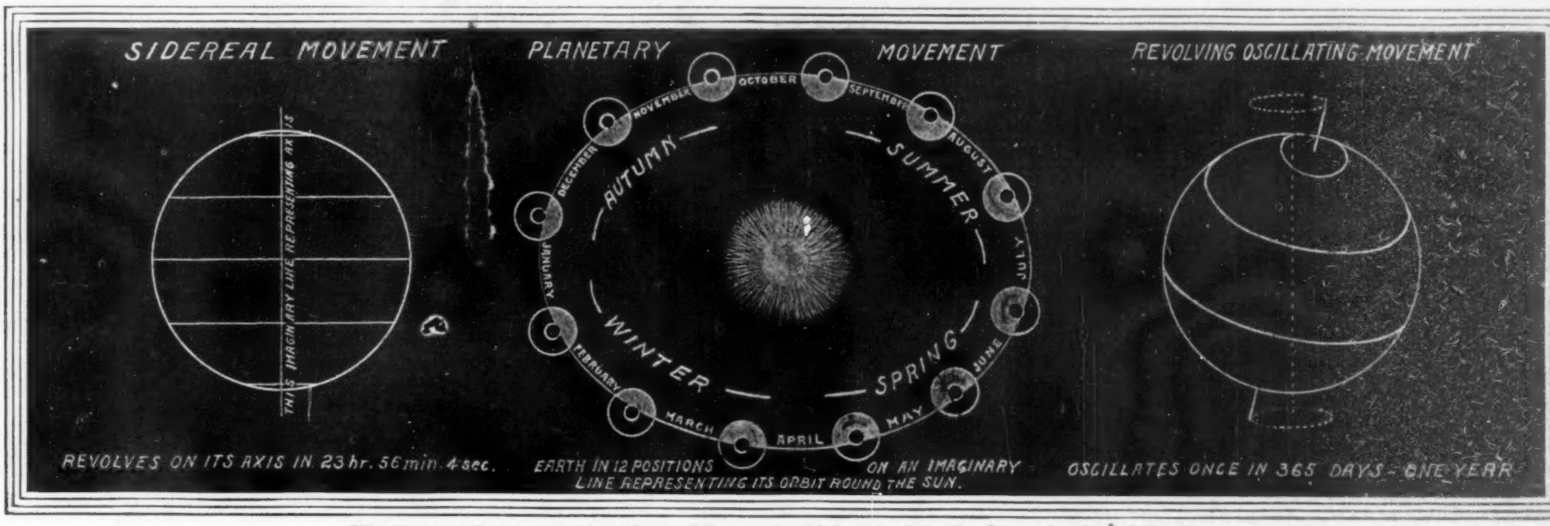

The three real or apparent motions of the earth which enter into the determination of the time

Why It Is Twelve O'clock?

THIS is a question that should be of interest to every worker, for it designates the beginning of the mid-day rest. Yet whether we in common with the great majority break off our task at this instant or otherwise, we shall find, if we pause to reflect, that this instant of time is of great importance to us and to the world in general. Although we commence our work day at six, seven, eight, er even nine in the morning, stopping at a corresponding hour in the afternoon, we shall still find that the decisive moment of all our days is twelve noon.

Why? Is it because something occurs then that we can feel, enjoy or suffer? Hardly that; for nature's machinery moves without a tremor and the daily panorama is unfolded without a shock of any sort. Yet at mid-day something happens that we all know about—the sun stops shining on one side of the fence, and an instant later shines on the other side. Perhaps you will say that the instant the sun thus changes from one side to the other it is twelve o'clock noon. This is true, however, on only one day in every three months; for our clocks, though regulated by the movement of the earth—or as it is more often expressed "by the movement of the sun"—will record this instant before or after noon according to the season. For instance, on November 1st the sun is 16¼ minutes in advance of the clock, while on February 10th it is 14½ minutes behind.

Our fence is merely a form of sun dial giving us the time the sun passes across its top, and measuring between two such moments the duration of a solar day. If the earth moved only upon its axis such days would be a trifle shorter than they are. But the earth also moves about an almost circular path through 360 degrees a year, or about one degree each day; and this corresponds to about four minutes of time. So when the earth has made a complete revolution, commencing with solar noon yesterday, it must still perform a further fraction of a rotation in order to bring the sun again vertically above the fence, completing the observable day. Hence we see that a solar day is about four minutes longer than a sidereal day—the latter being the term we employ to designate the exact interval of time in which the earth rotates through 360 degrees or one complete turn about its axis.

Were the axis of the earth perpendicular to the plane in which it pursues its invisible forward path about the sun, all solar days would be of one length. But the axis of the earth is inclined at an angle of something like 22½ degrees to the plane of its orbit, and maintains that inclination, pointing always to the same quarter of the heavens, throughout its complete journey about the sun. So if we consider the sun as the fixed point of reference, we find the earth's axis oscillating slowly through a circle over which it travels once a year. This motion of the earth's axis with reference to the sun is what causes the seasons; and bearing in mind that it is merely a relative motion, we may recognize it as a third motion of the earth from the standpoint of time determination, and admit it to the picture as we have done.

With a difference of twenty minutes in the length of the days during the year, caused by this third motion, it will be found difficult to make an ordinary clock or watch keep time with the sun as it makes its daily journey across our fence. There are astronomical clocks that are regulated to follow the various changes of the day as based on the action of the sun at its meridian or noon hour, but these instruments are too scientific for common use. Yet for the convenience of society it is customary to call the solar day 24 hours long; and as it is really of unequal lengths through the year, astronomers to obviate this difficulty insert an imaginary *mean sun* moving through the equator of the heavens with a uniform motion. When this mean sun passes our fence it is *mean noon*; and when the true sun is in the same position on the ridge it is *apparent* noon. The former gives us days whose length is the average of the real lengths of the apparent days throughout the year; and our clocks in common use are regulated to keep mean time.

The solar day is, as we have shown, about four minutes longer than the sidereal day. Of the latter in fact there are 366 per year, and if we had any convenient way of observing the sidereal day we would note 366 revolutions of the earth about its axis in the year—though the sun crosses the sky above us only 365 times in the same period. The extra sidereal day of course is required in catching up with the forward movement of the earth in its orbit. We see the sun but 365 times although if we ignore it and look at the axis of the earth alone we shall discover that our globe performs 366 axial rotations per year.

Without mean time our clocks will not behave. In France until 1816 apparent or sun time was used, and the confusion was so great that the town clocks would differ by as much as 30 minutes in striking the same hour, while no watchmaker could regulate a timepiece to keep time with the sun. One can only read a sun dial accurately with the aid of an almanac which gives each day an entry "sun fast" or "sun slow," telling how the apparent sun compares with the mean sun for the day. Of course on four days the true sun coincides in position with the apparent sun. In our latitude these are April 15th, June 15th, September 1st and December 24th.

The present scheme of dividing the day into two parts of twelve hours each has existed since the time of Hipparchus, 150 years B. C. Until recently, however, many nations terminated and commenced their official days at sunset; the Puritans commenced at 6 P. M.; and the "civil day" has usually extended from midnight. Of course for the same reason that the layman finds this division most convenient, the astronomer prefers to change his date at twelve o'clock noon, when his business is at low ebb.

The division of the day into hours dates from the original sun dial; and the notion of sixty minutes and sixty seconds must be traced back to the Babylonians, who combined the decimal and the duodecimal systems of numeration, and chose sixty as a convenient measuring aggregate because of its large number of exact factors.

Yet with all our clocks, watches and scientific apparatus—for all our machines to record the divisions of the day—we still find that the earth is our timepiece. It is the sun crossing the top of the fence at twelve o'clock noon that really marks the length of our day; for when we have taken into account all the perturbations which it undergoes from recognized causes, this phenomenon has not suffered a change of 1/100 part of a second in 2,000 years— and this is a record that we will hardly hope to duplicate with mechanical timepieces. That is why twelve o'clock noon is the instant when the astronomer makes his time-recording instruments correspond with the gnomon's infallible shadow upon the meridian of a modernized sun dial.

Thus it is that by the mere shifting of a shadow—a thing without substance and as light as the zephyrs of spring—that the whole fabric of society is regulated. We work according to the shadow's time, legal papers are drawn in accordance with its dictates. The shifting of a shadow has developed the human mind and brought man out of savagery, educated him, and made him the highly cultured, civilized creature he now is.—*W. M. Butterfield.*

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Newport or New York for the Cup Races

FOR many good reasons it is to be hoped that the races, this year, for the America's cup will be held over the historic course off Sandy Hook and not, as suggested, off Newport. In the first place, there is the strong argument of historic continuity. It was in 1851 that the "America" crossed the western ocean and won her brilliant and epoch-making victory against a fleet of British yachts; and ever since the surviving owners of the ship gave the cup for a perpetual challenge trophy, all of the contests have taken place off New York—in the earlier years, over a course in the Lower Bay, and later over the outside course off Sandy Hook lightship.

The popularity of these races has been attested by the great fleet of yachts and excursion boats which has always followed the contending yachts around the course. Ultimately, indeed, the fleet grew so large and crowded so closely in upon the yachts as very seriously to interfere with their sailing. Consequently, some twenty years ago, a movement was started to transfer the races from Sandy Hook to the less-frequented and less-accessible waters off Newport. This, however, produced such a widespread national protest that the matter was reconsidered, and ultimately the Government placed some of its vessels, including coast guard cutters, at the service of the New York Yacht Club for the purpose of building a marine fence, as it were, around the course, and keeping the fleet of sightseeing boats at a sufficient distance from the yachts to prevent any interference. The plan has worked so well in the several races that have been held under this arrangement, that interference has been absolutely eliminated, and there is a widespread feeling today that the question of interference as a motive for a change from New York to Newport is no longer valid.

Another advantage that has been suggested in favor of the Newport course is that the prevailing weather conditions are superior to those off New York, the average winds being stronger and holding more true. But against this is to be urged the much more frequent prevalence of fog at Newport. The yachting representatives of the press will not soon forget that in the summer of 1914, when the elimination races were being held off Newport, they spent a whole week fog-bound in the little town, and that on one day when a race was pulled off, the yachts had to sail in such thick weather that the "Resolute" was disqualified for crossing the line outside of the mark boats.

Another argument, which perhaps should be more potent than any, is the fact that the challengers are acquainted with the weather conditions and the course off Sandy Hook, but are totally unacquainted with the conditions off Newport; whereas the American captains and crews are familiar with both. To transfer the yachting ground to a course entirely novel and untried by the challengers would put them to a disadvantage the extent of which can be appreciated only by racing yachtsmen. Perhaps a concrete instance of the value of local knowledge will serve to emphasize this point. It is a fact, well understood by those who frequent the Sandy Hook waters, that in the late summer and early fall the light winds which prevail have a tendency to swing around with the sun, and in beating to the outer mark, or in fact, in maneuvering on any course of sailing, a wise skipper will hold his yacht, as far as the contingencies of the race will allow, well to the westward of his opponent—this for the reason that the drawing of the wind around to the westward will inevitably put the westward yacht in the weather position and may, by its shifting, give it automatically a commanding lead over its competitor. More than once in the past twenty-five years we have seen one or other of the yachts placed far in the lead by this westerly tendency of the wind. These hazards of the weather are, or at least should be, pretty well known by this time to the yachtsmen from the other side who have made so many gallant attempts to win the cup, and to shift the course to entirely new waters, where the vagaries of the winds and tides are unknown to them, would be to put the visitors at a serious disadvantage.

Finally, there is an argument which is not supposed to, and indeed does not usually, figure in the great sport of yachting, but which in this case can scarcely be ignored. We refer to the fact that the races for the America's cup have made an appeal to the national spirit for which no parallel can be found in the whole field of sport. Surely it is a compliment to the purity and nobility of international yacht racing that so many thousands of the American people should be willing, day after day, to turn aside from the urgent calls of business and go so far afield, or rather afloat, merely to see a yacht race. This wonderful display of public appreciation may not help the naval architect in drafting the lines of a boat, or the sailmaker in putting the best curve in his canvas, or a skipper in giving the right set to a sail, but it does serve most powerfully to keep alive in the heart of the average citizen a love for the cleanest, the most romantic and the noblest sport in the world.

An Unhappy Term

HISTORY tells us that back in the days of absolutism a device commonly employed by impoverished monarchs to replenish their exchequers was the granting of exclusive authority to produce or to deal in certain commodities or to engage in certain lines of business. The privilege thus gained—it would be the wildest hyperbole to call it a right, since, beyond paying to the monarch a sum of money which he expected later to extract several times over from the public, the recipient had done nothing and contemplated doing nothing to earn any rights in the premises—the privilege was known as a "monopoly." France was perhaps the country in which the system was carried to the extreme. At times there were monopolies in every necessity of life, none of which could be purchased without thus paying tribute. The greatest abuses of all were in connection with the salt monopoly; here, in order to checkmate the tendency of the people to dispense with salt or to economize to the last possible degree, regulations were long in force compelling every head of a family to buy a minimum quantity each quarter regardless of what supply he might have on hand.

Now it is unfortunate that we have but the one word to indicate satisfactorily the exclusive right to enjoy a property or a privilege of any description. For to this word monopoly there has attached, through its use to characterize the indefensible royal monopolies of the sort described, a sort of opprobrium, an odor of unsanctity, a suggestion that anything to which the term attaches is necessarily and inherently bad by virtue of the very fact that it bears this name. We say that this lack of a substitute for the hated term is unfortunate, because a very brief reflection will make it clear that there are monopolies which are eminently good as well as those which are bad.

We suppose nobody will deny that some property rights exist. The most violent would doubtless object to the nationalization of the shirt off his back, or to the compulsion that he give up something else that he has striven to obtain. The heartiest socialist is probably at the same time an ardent labor unionist, and an advocate of the principle that his job is his own, rather than something that can be taken from him and given to a second party at the pleasure of a third. No, say what one will, one is bound to find property rights of some description, somewhere. And the property right is inherently a monopoly.

The man who has built a house enjoys the right to live in it, or if he does not choose to do so, to say who shall live in it. The man who has planted a crop enjoys the right to harvest and consume it. The man who has found after long search a place off in the hills where a certain very desirable yellow substance abounds acquires a right to remove the gold and enjoy the things it brings him. In every case the right outlined is a monopoly to do certain things to the exclusion of other persons. And this is true of every property right. We differ with one another as to what property rights are legitimate and what ones are not; but even if the only property were a job, this would be a monopoly—the right to work at a certain time, in a certain place, doing a certain thing, to the exclusion of some one else who was willing or eager to displace the possessor of this monopoly.

The justification or lack thereof of a monopoly does not then consist in the fact that this word can be used to describe it; we must seek somewhere else if we would find the reason why a particular monopoly should or should not continue to exist. And those who are opposed to the recognition of property rights actually give us the cue here, when they tell us that we have *done nothing* which can reasonably entitle us to any exclusive property right. This is the test whether a monopoly is justifiable—has the holder done anything to justify that he obtain certain privileges to the exclusion of his fellows? The word itself is not an inherently vicious name for a vicious thing; but every case of monopoly or attempted monopoly or proposed monopoly must stand or fall on its own merits.

Our Unpopular Weather Man

WHO, in all history, ever suffered unpopularity more widespread and more undeserved than the weather man? When his prophesies hit the mark, this is taken as a matter of course, and tomorrow will forget today's success. But his occasional failures—especially if rain comes when he had given his sanction to our plans for an outing—such impardonable failures are recorded in indelible writing, with illuminated capitals to impress the event upon the memory.

And, strangely enough, in this atmosphere of unforgiving criticism, the charlatan weather prophet still flourishes, and with blatant self-confidence foretells to a congregation of believers the weather for each and every day next year or the year after, or any other year. Old myths, negated anew by each year's experience, seem to have a charmed life, proof against the bullets of obvious fact. The scientific weather man, in modesty, forbears to predict anything but the immediate future—tomorrow, and perhaps the day after. Beyond this lies uncertainty. He hopes, indeed, for a future development of his science when, aided by more complete equipment, he may be able to give at least an approximate indication of more remote events. As yet, however, this is but a pious hope.

But the charlatan is not encumbered with any such impediments of modesty. It is just as easy to foretell the weather a hundred years ahead as a hundred hours or minutes—it is even easier, for there will be none to call you to account if you miss the mark.

In this the popular attitude is much the same as in the matter of medical attention. The doctor's successes are soon forgotten; his inevitable failures—for the foe is in the end invincible—are burnt into the memory. And those who are most vociferous in their criticism of the *bona fide* physician faithfully plying his science, are commonly the first to turn to the charlatan for aid in the time of trouble. Truly, they receive their reward.

The harm done is perhaps not so very great. The physician goes on his rounds regardless of undeserved fault-finding; and the weather man continues to publish his bulletin day by day, undisturbed by criticism.

Yet our sense of justice impels us to plead:

In mercy, good people, be charitable, and remember that the weather man only *foretells*, he does not make the *weather*.

Engineering

Developing the Water Power of the Dutch Indies.—According to *Engineering* a survey has recently been made of the available water power in the Dutch Indies, which shows that this amounts to a million horsepower. Conditions would allow of establishing power stations in certain districts of one hundred thousand horse-power. It is proposed to produce nitrates from the air in Central Celebes and Sumatra. However, the cost of harnessing the water power has not yet been fully investigated.

New Tractor for Canal Traffic.—Successful experiments with a new hydraulic tractor for towing canal boats have just been conducted at Liége, Belgium. The new apparatus insures much more rapid transit and is also less expensive than towing by steam, horse- or man-power. Boats of 350 to 400 tons which now require 10 to 12 days to make the 95 miles from Liége to Antwerp arrive at their destination in five or six days under the new system. It is also claimed that the hydraulic tractor has the advantage of not injuring the towline in getting under way, and the danger of collisions with other boats and with quays and embankments is diminished. There is also a saving of time in passing through the locks. The importance of such a development is of course greater in this particular corner of the world than almost any other.

Large Canadian Irrigation Projects.—In accordance with the Dominion Government's plans for a thorough investigation into the possibilities of irrigation in Alberta, seven survey parties are now in the field in various parts of the Province. One survey is complete and one will, it is stated, be completed this season, and practically all the others are expected to be complete in 1920. Various projects affecting territory in the vicinity of Lethbridge, one in the Medicine Hat district, and a large scheme for obtaining water in the North Saskatchewan near Rocky Mountain House, for the irrigation of a portion of eastern Alberta and western Saskatchewan, are among those now under investigation.

Japan's Submarine Tunnel.—Several months ago announcement was made that the Imperial Government Railways of Japan intended to build a tunnel under the Shimonoseki Strait. This strait separates the main island of the Japanese group, Hondo, from the smaller island of Kiushu at the south. It is now crossed by a car ferry, which is rapidly becoming insufficient to meet the demands that are made upon it. Two years are to be spent in studying the geological formation of the sea bed in the strait and in drafting of the general plan of work in preparation for the actual undertaking of tunneling, so that the real work will not commence until 1921. Engineers and workmen will be sent to America and Europe to make a study of what has been achieved in these countries in the way of tunnel engineering. The line is to be seven miles long, one mile of which will be entirely under the sea. The approximate cost of the undertaking will be about $10,000,000 and the work is expected to be completed in 1928.

Laying a Long Steel Pipe Under Water.—An interesting piece of engineering work has been done at the point where the Jersey City Water Supply Line crosses the Passaic River. Here, a pipe with an internal diameter of six feet and measuring 452 feet in length has been laid in a single piece in 26 feet of water. The pipe is incased in 3 inches of wire-reinforced concrete, the concrete being deposited by means of the cement gun. The concrete-cased pipe weighs about a ton per foot. A launching way was laid in a trench dug on shore and the pipe as it was complete was supported on cars running down a track in the trench. In order to deposit the pipe without strain in the submarine trench which had been dredged across the river, two parallel trestles were built between which the pipe was slung from timbers that were carried by cars placed at 25-foot intervals. These cars were connected by means of cables and were moved out across the river as the pipe was being built, and when completed the pipe was sunk by admitting water into it. In order to hold it down it was weighted with cast-iron blocks at each end. A goose-neck rises from the submarine section at each end and connects with the shore sections.

Astronomy

Variations in Eros.—Measurements of the brightness of the minor planet Eros made by Miss Margaret Harwood on plates taken at Harvard College Observatory in 1900 and 1901 show that the planet was varying almost continuously in brightness from November 1st, 1910, to June 21st, 1911. The variation range fluctuated between 0.4 and 1.5 magnitudes, but only the minimum light varied, the maximum remaining constant. The period of the light curve also seems to vary.

Audibility of Wireless Signals During Eclipse.—The effects of solar eclipses on the transmission of radiotelegraphic signals was a special subject of investigation during the total eclipse of May 29 last. The first report of results comes from the observatory of Meudon, France, where wireless receiving apparatus was installed under the direction of General Ferrie, in charge of the radiotelegraphic services of the French Army. Messages sent from the English wireless station in the island of Ascension are heard at Meudon by night, but not by day. During the period of totality in the recent eclipse, however, signals from Ascension were heard strongly at Meudon. After totality the signals diminished in intensity and ceased to be audible at the end of the eclipse.

Astronomical Uses of Radium Paint.—One of the interesting developments of the war was the extensive use made of luminous paints for the dials of airplane instruments and other apparatus; the paint being rendered luminous by the action of radium salts on zinc sulphide. The application of such paint to the dials of watches is becoming familar. M. Quenisset, of the Flammarion Observatory at Juvisy, has recently pointed out that good use may be made of radium paint in astronomy, as it is found very convenient for illuminating the cross-wires of telescopes. The degree of illumination may be varied, since it is now possible to buy paints which are more or less luminous according to the amount of radium bromide they contain. Radium paints will also be found useful for illuminating the divisions of circles and verniers, details of star-maps, etc.

An Examination of Nebulæ for Polarized Light.—It has frequently been suggested that the spiral nebulæ and certain types of extended irregular nebulæ shine by reflected light. In the case of spirals the light has been thought to be reflected from their nuclei, and in the case of the extended nebulæ from stars within or near them. If this hypothesis is correct, the light coming from the nebulæ should show polarization. Mr. W. F. Meyer has recently reported observations made on several nebulæ with a special form of polarigraph used in connection with the Crossley reflector of the Lick Observatory. Satisfactory observations were obtained on 12 nebulæ, and in no instance was the evidence of polarization sufficient even to warrant a suspicion of its presence. Mr. Meyer concludes that if some of the light coming from the nebulæ under investigation is modified by reflection or scattering by small particles, the proportion of light thus polarized must be less than 10 per cent of the total received from these objects.

Shapes of the Globular Star Clusters.—The flattened shape of the galaxy (often compared to a grindstone) seems to be in accord with a general rule applying to aggregates of stellar and nebular matter throughout the universe. The solar system is, of course, conspicuously flattened, and so are the spiral nebulae. What of the so-called "globular" clusters? A recent paper by Dr. Harlow Shapley and Martha B. Shapley deals with this question and presents results obtained from an examination of 41 such clusters. The authors state that the observed elliptical distribution of stars in the photographic images of globular clusters is really an indication of flattening with respect to more or less symmetrical equatorial planes. In other words, these bodies are probably oblate spheroids or ellipsoids, though their flattening is very small in comparison with that of spiral nebulae or with what appears to be the form of the general galactic system. Another interesting question is that of the orientation of the globular clusters with respect to the galactic plane. The evidence adduced suggests that the equatorial planes of the clusters nearer the galaxy are roughly parallel to the galactic plane, while the more distant ones are oriented at random in space.

Industrial Efficiency

Pineapple Evaporator Plant.—Preparations are under way for the installation of a pineapple evaporation plant at Grahamstown, Cape Province, South Africa. The plant is to be erected by an English company, a representative of which is on the ground. It is understood that the company will grow pineapples on a 5,000-acre plantation in that vicinity, which will be prepared for shipment to all parts of the world.

German-Austria Coal Supply.—As a result of the revolution German Austria lost all its sources of coal supply. Only 5,000 tons per day, that is, 12 per cent of the coal required in 1913 for railway, industrial and household purposes, is now produced in German Austria; 88 per cent must be imported. As the German Austria coal is of a poor quality, the 12 per cent must be reduced to 6 per cent. One of the activities most affected is the railroads.

Japanese Rubber Industry has made great strides since the outbreak of war. It is expected, says the *Japan Chronicle*, that orders for rubber goods will flow in from Europe, and, indeed, the export of rubber tires during the present year has been enormous. A further development of the industry is looked for in the shape of a combination of large and small rubber factories. The desirability of this scheme seems now to have been accelerated by the receipt of large orders from Siberia.

Reed-Weaving Machine for Disabled Soldiers.—The Australian Government has paid £50,000 (nearly $250,000) for the use of the patent and for two complete units of a reed-weaving machine of American make. Public criticism on the grounds of the extravagance of the transaction has been severe, but the Government has issued a pamphlet giving its reasons for the purchase. There were imported into Australia in 1911, 1912, and 1913, respectively, $90,000, $100,000, and $60,000 worth of articles made of wicker, reed, cane, etc. It is believed that with the aid of this machinery the demand can be satisfied without importations. But a better reason is found in the statement that under this scheme disabled soldiers will be furnished employment, and men who have lost an arm or leg in the service, or those who have suffered in other ways, will not be left to drift, but will be definitely helped in their fight to earn a living.

Using Water for Blasting Rock.—A writer in a German technical paper describes a hydraulic device for blowing up rocks, and, in particular for demolishing bridge piles and ferroconcrete foundations. It is based on the principle of the hydraulic press; enormous pressures are set up within the rock, which eventually bursts. The pressure is transmitted by a pipe-line to a cylinder 85 millimeters in diameter in which eight pistons may be successively displaced telescopically. The cylinder is inserted into a hole, drilled by an electric drill in the rock to be blown up. The pistons bury themselves in the rock one after another and blow up the rock. The holes take 10 to 15 minutes to drill (they are about 2.5 centimeters deep), and in 5 minutes after that the rock is shattered. It is said that this device has proved successful in mines and quarries where the use of explosives would be dangerous.

A New Metal Packing.—An interesting material, which may perhaps best be described as metal fiber, is on the market for use as a packing in all joints, etc., which are under pressure. The substance is 90 per cent metal, while in structure it seems to be partly shreds somewhat similar to asbestos, and partly an impalpable powder. It cakes under pressure in such way as to hold a shape, but never becomes too hard to be broken and crumbled by the fingers. It is described by the makers as "a plastic metallic composition that is easily compressible." Any fresh material will readily combine with the old into a homogeneous body, while the packing can always be withdrawn with ease and every particle used again. It is claimed that the packing is self-lubricating under all conditions, that it never scores or even tapers a rod, that it never hardens, perishes or crystallizes and that it loses none of its qualities or characteristics at any temperature or any pressure. Its only limitation is that it requires some pressure continually to keep it in shape, and therefore cannot be used as a packing where there is no pressure.

Wood Alcohol

What It Is and Why It Is Deadly to the Human Mechanism

By H. E. Howe

SINCE one of the results of prohibition must inevitably be a temporary increase in the amount of alcoholic liquors produced and sold through unauthorized and irresponsible agencies, it need hardly surprise us to read of widespread poisoning through the consumption of alleged whiskey which turned out to be wood alcohol. Just what this substance is and why it is so deadly are points which are somewhat obscured by its very close resemblance, so far as anything capable of immediate observation is concerned, to the legitimate grain alcohol. We have asked Mr. Howe to make these points clear to our readers, and in this article he has done so.—THE EDITOR.

IT is surprising that while everyone recognizes that in most instances the identity of names can never be taken as a guarantee of identity in characteristics, the term "alcohol" seems to mean the same thing to many notwithstanding all that has been preached and published concerning the one essential difference between the two most prominent alcohols, namely, the poisonous nature of one and the comparatively non-poisonous properties of the other in the human body.

There are many alcohols, but the two under discussion are the best known to the majority of people. Speaking from the standpoint of organic chemistry, wood alcohol is methyl alcohol and is conceived to have a molecule represented by the formula:

$$\begin{array}{c} H \\ | \\ H-C-OH \\ | \\ H \end{array}$$

usually written CH_3OH. Grain or beverage alcohol is ethyl alcohol and its formula may be represented by:

$$\begin{array}{c} H \quad H \\ | \quad\ | \\ H-C-C-OH \\ | \quad\ | \\ H \quad H \end{array}$$

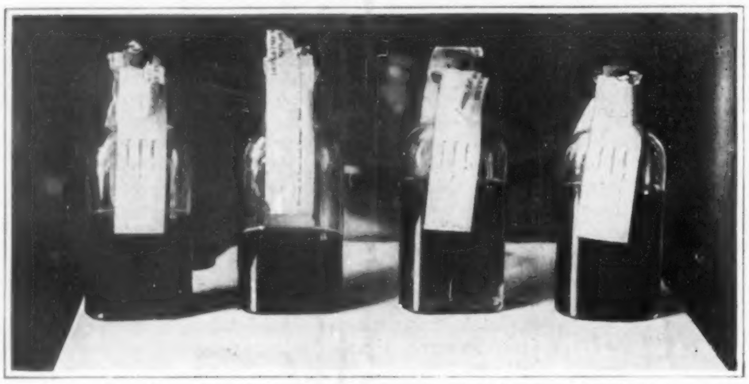
usually written C_2H_5OH

Until recently these alcohols were always prepared from decidedly different raw materials. Wood alcohol is procured as the result of distillation of wood without free access of air, and different varieties of wood produce different quantities of alcohol but its characteristics do not differ with the kind of wood. Grain alcohol, as the name indicates, is produced principally from grains, notably corn, by the fermentation of the carbohydrates present and the distillation of the resulting material.

During the last few years research has made it possible to produce the grain variety from wood but not by fermentation direct. The cellulose in the wood is first converted by an acid treatment into a fermentable carbohydrate and when that has been procured the remainder of the process is quite similar to the one regularly employed in producing grain or ethyl alcohol. Molasses is now largely used as a source of carbohydrate which is fermented to produce grain or ethyl alcohol.

The two alcohols in their pure state are very similar. They form the same series of compounds by different degrees of oxidation. Thus we have both methyl and ethyl ethers, aldehydes, and various additive compounds produced by the substitution of other groups for the hydrogen or the hydroxyl group held by the carbon atom; and finally there is formic and acetic acid which represent the acid members of the methyl and ethyl families respectively. The solvent properties do not differ greatly but when used with animal tissues biologists have found that there is a considerable difference in the action of the two alcohols and that tissues which can be fixed almost instantly by methyl alcohol are fixed much more slowly by ethyl alcohol.

At one time it was held that the poisonous nature of methyl alcohol was principally due to the impurities usually contained in it, and brands of chemically pure material were introduced under such names as "Columbian spirit" and "Colonial spirit." Because of their similarity to "Cologne spirit," which is ethyl alcohol, some modification of these names for methyl alcohol has been introduced more lately; for example, "Columbian methanol." Indeed, at one time the manufacturers of extracts and other preparations in which ethyl alcohol has been largely employed were urged to substitute the methyl variety providing that the chemically pure substance was employed, and this led to a number of fatalities—though fewer than might have been expected—probably because of the extremely small dose which most people received through the use of such preparations and the recognized variation in susceptibility of individuals to this form of poisoning. Thus some people die while others are blinded by approximately the same quantities of wood or methyl alcohol.



Samples of "wniskey" which turned out to be wood alcohol

There is one other alcohol which has become well known, namely denatured alcohol, and so far as use internally or externally is concerned, this is practically as dangerous as methyl alcohol because in the majority of instances denatured alcohol is ethyl or grain alcohol which has been rendered unfit for such use by the addition of ten per cent of the wood or methyl variety, and this is sufficient to make it a deadly poison under some circumstances.

Not only must wood alcohol not be taken internally, but it cannot be used either as such or in denatured alcohol for rubbing or other uses about the body. It has been determined that the skin will absorb sufficient alcohol to cause poisoning, and the vapors themselves have been known to cause blindness if indeed not death when wood alcohol has been used extensively in the arts in rooms lacking proper ventilation. Wood alcohol therefore is poisonous in any form and this cannot be emphasized too strongly.

Now when ethyl alcohol is taken into the body it produces a temporary stimulation through its effect in rapidly increasing the circulation, which goes on however at the expense of the body temperature and, as is well known, is followed by a reaction expensive to the body organism. The alcohol itself is soon broken down into water and carbon dioxide which are harmless substances always present in the body. Excesses of these materials are constantly eliminated through the lungs and the kidneys. However, when wood alcohol is taken into the body it is believed to act in an entirely different manner, remaining for a considerable time in its original condition and then breaking down slowly into formic acid which is a poisonous substance. The work which has been done by Dr. Reid Hunt and others has led to these conclusions. There may be other decomposition products resulting from the action of wood alcohol in the blood stream, and some believe that acetone, formaldehyde and similar substances may contribute to the poisoning. Nausea and vomiting, violent headaches and vertigo, ending in coma and death, are the various progressive stages of the poison's effect, and very often, due to the degeneration of the ganglion cells of the retina, amblyopia, which is a dimming of the vision without a discoverable change in the eye, takes place. The result in that case is, at best, temporary blindness and usually permanent blindness, depending upon the extent to which the ganglion cells are destroyed.

While it is not difficult to distinguish between the commercial grades of wood and grain alcohol, it is increasingly difficult as the wood alcohol becomes purer, and obviously it is quite impossible to distinguish wood alcohol in blends which have been colored and flavored to suit some particular purpose. This would be as difficult for the chemist without an analysis as for others, and therefore no one's snap judgment can be trusted as to the safety of some particular beverage.

From the chemist's standpoint the recent poisonings due to wood alcohol are very unfortunate, for the material is an important solvent and reagent in industrial chemistry in its many ramifications, and it is feared that a continuation of the troubles reported daily in our press may lead to restrictions which will add to the burdens of the manufacturer who uses this material legitimately. So much has been preached and printed concerning the certain poisonous effects of wood alcohol used in any quantity about the human body that it should have made a lasting impression, but there continue to be large numbers who apparently must try it themselves in order to be convinced.

Health Department chemist searching for wood alcohol in "whiskey"

American Silk Troubles

THE exodus of Italian working men returning to Italy has seriously affected the silk industry in the United States, which is handicapped by an increasing shortage of skilled workmen. Thousands are said to have left the silk manufacturing centers of this country. There have been reports that American manufacturers contemplate the establishment of silk manufacturing plants in Italy and several arguments in favor of such a plan have been brought forward. Skilled workers are scarce in this industry, whereas in Italy not only is labor more plentiful but it is believed that it will be possible to attract returned immigrants who have been trained in American mills.

Some Vegetable Parasites

Flowering Plants and Fungi That Derive Nourishment from Other Plants

By C. Geoffrey Nicholson

OF the vaious types among our familiar flora, the parasites are certainly not the least interesting. The number of species of our parasitic flowering plants is limited, but at any rate one of them, the mistletoe, is well known to all as a Christmas decoration, if not at home on its host. On the other hand our species of parasitic fungi are numerous, and several of them, such as the conspicuous white rose-mildew, must be familiar to most of us.

To understand fully the part played by parasites in the vegetable world, it is necessary to have some idea of the process known as photosynthesis. In this process a plant uses the comparatively simple substances, carbon dioxide and moisture from the air, for the formation of complex organic substances, consisting of carbon, hydrogen and oxygen combined in different proportions. The carbon dioxide enters the leaf by means of the stomates—those microscopic openings which are so numerous that a sunflower leaf has about twelve millions of them—and is then decomposed by the chlorophyll—the green coloring matter of plants—which builds this carbon up into the various organic compounds required by the plant. It is in this way that a green plant gets the whole of the carbon needed for its growth. But this process, which is only carried on in the light, is absolutely dependent on the presence of chlorophyll. Therefore, a plant which is devoid of chlorophyll, must, of necessity, obtain the whole of its organic food from the air by an indirect means. Such a plant is the total parasite.

Parasites are said to be total or partial according to whether they obtain the whole or only part of their food from the plants on which they grow. The greater, lesser, flax and clover dodders are all practically total parasites growing on the stems of various plants; while the toothwort and different species of Broom-rape are parasitic on roots. Among the partial parasites we have the mistletoe (*Viscum album*), and several members of the figwort family (*Scrophularinae*). Total parasites are entirely devoid of chlorophyll, and are therefore unable to perform the process of photosynthesis or "assimilation of carbon from the air." The carbon, which is necessary to all plant life, they obtain from the host, which is accordingly robbed by them of its very life's blood.

Let us now consider one example of each kind of parasite. The clover dodder (*Coscuta trifolii*), a total parasite, is a twining plant. It is devoid of leaves and has wax-like flowers. When the seed first germinates in the soil, it sends a short radicle into the ground, and the thread-like shoot, which rises into the air, at once searches for its prey. If it fails in its search, the young plant soon dies, but woe betide the unlucky clover which happens to be in its reach! The reddish yellow stem of the enemy climbs up the clover, and sends its suckers to draw from the host the carbon compounds the latter has labored to make, together with water and salts. Once established, the dodder loses its connection with the ground, and clings to the clover throughout the summer, flowering, producing and shedding its seeds, and then shrivelling away.

The best known partial parasite is the mistletoe (*Viscum album*), which belongs to the natural order *Loranthaceae*. It grows on the apple and several other kinds of trees, deriving from the branches of the host the nourishment it fails to get by means of its leaves. The general appearance of the mistletoe is too well known to need description; it suffices to say that its white, sticky berries are preceded in early spring by small green flowers.

Among our fungus flora the parasites are still more interesting and of much greater importance. The number of species is large, and the variety of form and size surprising. Thus we have small fungi, such as the mildews and the rusts, and, as examples of large ones, the woody, bracket fungi (*Polyporus* and *Fomes*), which are mostly wound-parasites.

Gardeners are assailed on all hands by the ravages of fungi. A minute kind (*Pythium*) causes "damping off" in seed beds. The white, powdery covering, often seen on rose leaves in the summer months, and known as mildew, is in reality the conidia or summer fruit of another fungus. Among the "rusts" we have *Puccinia malvaccarum*, which produces hard, brown spots on the leaves of the hollyhock. The potato disease about the prevention of which we heard so much during the war, when the potato crop was of such importance, is due to the destructive parasite, *Phytophthora infestans*. During the summer the disease is spread by the wind, which carries the conidia (which may be regarded as the seeds of the fungus) from infected plants to the leaves of those free from disease. Assuming the conditions to be favorable, these spores will germinate, and not only will they produce more spores the same season, but also the mycelium or spawn will travel down the stem of the newly attacked plant to the tubers, in which it hibernates till the "sets" are planted next season. It then makes its way up the stems to the leaves, where more spores are formed, which in their turn are dispersed. Thus the cycle of changes goes on.

Our trees have their parasitic fungi, small and large. Has the reader ever noticed those black blotches which are not infrequent on the leaves of the maple? These are the work of the *Rhytisma accrinum*. This fungus is merely confined to the leaves themselves; its mycelium does not penetrate the tree proper. When the affeted leaves fall—their fall is premature—the tree is free from the parasite, but next spring, with the opening of the new leaves the spores ripen on the leaves of last year as they lie on the gound, and with the help of a friendly breeze, the next generation of *Rhytisma accrinum* establishes itself on the tree. Conifers have a terrible enemy in *Fomes annosus*. The mycelium—that network of threads, better known as "spawn," which riddle the matrix occupied by a fungus and, at a particular season of the year, varying according to the species, give rise to the more obvious, fruit-producing organs—spreads up the center of the trunk of the tree attacked, destroying the tissues and hollowing out the stem. It thus spoils the forester of his timber, and ultimately brings about the destruction of the host.

During the present summer the author came across an ash destroyed by *Polyporus squamosus*. The physical nature of the stump was curious: the wood was very light, in parts it was quite spongy, and it was so soft that large pieces could be readily cut from it with a penknife. The fungus, popularly known as dryad's saddle, was, in this particular case, grouped, there having been at least two fungi united by a common base and overlapping considerably. The total span was 20 inches, the span of one of the fungi alone was 16 inches, while the maximum width was about 10 inches. This fungus has been known to attain much greater proportions: Sir William Hooker speaks of one with a circumference of 7 feet 5 inches and a weight (four days after cutting) of 34 pounds; this size had been reached in four weeks. (See Sir William Hooker's "Flora Scotia.")

A fungoid disease may add really an artistic charm to a tree. *Ascomyces turgidus* is very common on the birch, and this fungus brings about the formation of masses of twigs, resembling large and untidy birds' nests and known as "witches' brooms." A birch attacked by this fungus, seen in winter against a clear sky, has a beauty of its own: the "brooms" give to the picture quite a look of Japanese art.

Several methods are employed for safeguarding plants from fungoid attacks. In the first place, as a precaution against the "damping off" fungus, which causes seedlings to fall over and die by the score, it is well to sterilize the soil, in which seedlings are to be reared, by heating it up to 150 degrees Fahrenheit at least

(*Continued on page 97*)

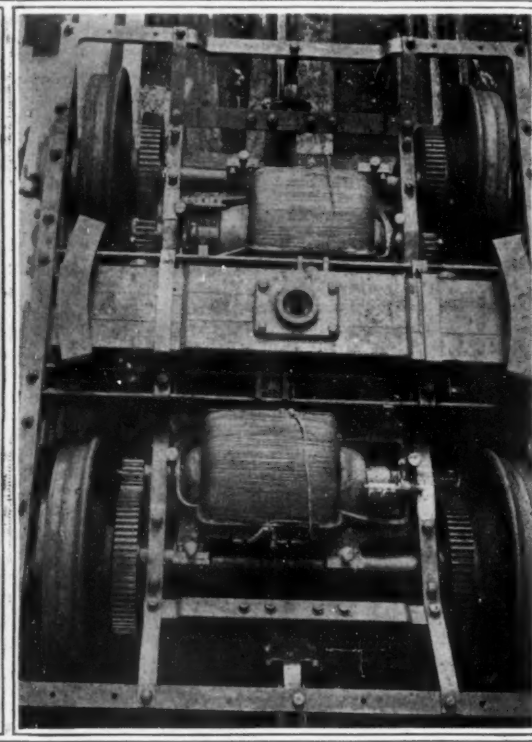



Left: **A typical mistletoe.** ***Center, above:*** **Maple leaf, showing blotches due to *Rhytisma acerinum*.** ***Below:*** ***Polyporus squamosus*, showing plainly the ridge where the two fungi overlap.** ***Right:*** **A heavy growth of witch's broom on a birch tree.**

Four of the more common parasitic members of the vegetable kingdom

Head of first multiple-unit car; run on banks of Erie Canal, July 16, 1897

Frank Julian Sprague, a pioneer and leader in electrical development



First pair of wheelbarrow suspension motors ever built; date 1885-1886

The Romance of Invention—VII

A Pioneer of the Electric Motor, the Trolley Car, the Multiple-Unit-Train-Control, the Electric Elevator

By C. H. Claudy

INVENTORS there have been whose talents lay so wholly in invention, and so little in life, that they lacked either the driving force to get their ideas before the public, or the ability to make friends or at least believers who would attend to such details for them. But once in a while there appears a man whose grasp on business affairs is equal to his superlative inventive ability—an inventor, a fighter, a pusher—one who is not content to produce what is new and better, but who will fight to the last gasp and the last penny to force an uninterested and reluctant world to adopt what he has to give. Such a man is Frank J. Sprague, who more than any other one man must be recognized as having brought electric transportation into being.—The Editor.

IF invention consisted only of the conception of an idea, or the development of it in experimental form to practical perfection the world might be much further on its way to the millenium than it is. Unfortunately there is invariably the complication of money, of existing interests and the inertia of the thing-that-is, to be fought by any new and revolutionary idea before it can get a trial, let alone be adopted.

Many inventors have never lived to see the fruits of their labors because their allotted span was not great enough to see the end of opposition to that which was good. There have been inventors whose talents lay so wholly in invention and so little in life that they lacked either the driving force to get their ideas before the public, or the ability to make friends who would attend to such details for them.

Once in a while there appears an inventor and discoverer who is also a fighter, a pusher, even a gambler, who is not content merely to produce that which is new, different and better, but who will fight to his uttermost to make an uninterested world adopt what he has to give, and gamble to his last penny, his last ounce of strength in the faith that what he has done is worth while.

Such is Frank J. Sprague . . . and no one meets him and talks with him long without realizing the driving magnetic force of personality behind the business-like exterior, as being fully as much responsible for the success of the numerous Sprague inventions as were the brains which produced so many things electrical, new, novel, different, revolutionary.

Mr. Sprague's life has been one long fight . . . and apparently to fight and fight hard is an excellent recipe for having a good time, so much so that he no sooner finished up one scrap to get his inventions before the public and adopted than he initiated a new one.

His entire career has been pugnacious, dating from the time when he graduated from Annapolis and after a world cruise became an ensign, to the present day when he is vigorously engaged in forcing upon the attention of railroads a system of automatic train control.

It would be idle, in the space here available, even to attempt to summarize the life history of a man whose various contributions to electrical progress have vitally affected so many industries. Mr. Sprague himself divides his principal life activities after leaving the Navy into six epochs: first, the development of the first constant speed, non-sparking motor and the introduction of electric motors to industrial purposes; second, the development of the electric trolley railway, including the "wheelbarrow" suspension of motors; third, the conception of and making practical of electric elevators and the fight to have them displace the hydraulic and steam elevators, with all that is meant in contest with a large and well established industry; fourth, the invention and perfection of the multiple-unit system of electric train control, and the long and discouraging fight to get it adopted; fifth, the propaganda for use of high tension direct current for electric railway operation; and sixth, the present contest between indifference, lack of knowledge and non-belief in the development of a system of automatic train control, which general improvement he is positive must eventually be adopted for main line operation.

Mr. Sprague's interest in electricity dates from Annapolis days. He treasures as a curiosity a note book kept during his first voyage as a midshipman, in which are all sorts of possible and possibly impracticable electrical inventions, some of them showing the germs of successful and practical ideas later made and worked out by others.

It is really a remarkable list, when it is considered that it is the work of a boy of from twenty to twenty-three years of age cruising in Asiatic waters, and one who had yet not entered upon the career which was to bring him both fame and fortune. The list of devices thus originated before their time of commercial birth includes arc and incandescent electric lights, many different examples of possible duplex, quadruplex and multiplex telegraphs, a selenium telephone, a duplex telephone, a steam turbine, an electric motor (this was at sea in 1879) a facsimile writing telegraph, ice machines and water filterers, and many inventions pertaining to naval matters, such as the gyroscopic control of an artificial horizon, an adjustable steam valve stem, steering propeller, reversible training gear for guns, et cetera. Altogether, Mr. Sprague anticipated a famous catch line advertising phrase by conceiving and making drawings and notes of "fifty-seven varieties" of inventions, during his note-book days on shipboard, and only the facts that laboratory and workshop facilities were entirely lacking and an ensign's pay hardly adequate for the financing of original research, prevented many of these early ideas from being developed by him instead of by later comers into the field which he sought to fence off for himself.

Mr. Sprague also recalls with amusement the fact that he first tried to put electric lights on the old "Minnesota" and electric bells on another fighting ship. In view of the perfection of electrical installations of the modern fighting vessel, the newest of which is even driven by electricity, it seems odd that a living man can recall when there were no call bells, no electric lights, no electric motors, to do anything on a battleship. Mr. Sprague succeeded in getting a vessel wired for bells, but it is somewhat uncertain as to whether it always worked properly, and if at times the captain did not call the cook while attempting to summon the engineer. His scheme for electric lighting a battleship fell through because Mr. Edison very properly refused him the loan of a generator to be run from an old single cylinder converted steam pump, and therefore a most inconstant-speed prime mover.

It was not, however, until young Sprague managed by that wire pulling and effort which only one familiar with Government red tape can realize, in getting himself ordered, first to a ship leaving for European

(Continued on page 97)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Speed Versus Armor

To the Editor of the SCIENTIFIC AMERICAN:

Some years ago I was a machinist mate in the U. S. Navy and there had the opportunity of studying fighting craft first hand so to speak, but for years one question has remained unanswered in my mind or rather several questions.

For the last fifteen years I have been an interested reader of the SCIENTIFIC AMERICAN although not always a regular subscriber, due to the fact that business carries me all over the country, but I am taking the liberty of writing to you and asking the questions which have troubled me so long. If you consider the following letter worth publishing, I wish you would run it in your columns as I would like to read what others have to say in regard to the following subjects:

First, why don't marine engineers take heed of the data at hand and profit by the lessons taught them in the Great Battle of the North Sea? Namely, it is a well-known fact that no armor yet put on a fighting ship can stop a 14-inch 50-caliber shell at anywhere near a fighting range. The battle of the North Sea taught us that speed is the most essential thing or at least one of the most essential things in the dreadnought of today, for without the superior speed which their construction gave them, Admiral Jellico and his ships could never have out-maneuvered the German fleet as they did, in spite of their vast superiority in numbers.

As it is the breadth of beam and not the weight of the ship itself which gives a comparatively stable gun platform and as it is the interior bracing which gives the fighting ship the rigidity to withstand the recoil of the heavy guns, also the fact that the armor is vulnerable to the guns of the enemy; what I want to know is, why do fighting ships, dreadnoughts I mean, carry armor at all? The great war taught us that "camouflage" was far more effective than forts of steel and masonry. Why not apply the same principle on the sea so far as possible? That a gun pointer can hit a ship with a thirty-foot freeboard at let us say, 12,000 yards more easily than he can a ship with a ten-foot freeboard is a foregone conclusion, but why is this so? In spite of all the paint on earth, the higher ship can be seen farther and easier than the lower one. The fellow who can remain unhit the longest is the one who generally wins the battle, all other things being equal, but if the lower ship has the advantage of speed as well as that of more invisibility with the same number and size guns as her antagonist, why can't she simply walk away with victory if her gun pointers can hit a flock of barns?

The following is my idea, in general, of what a fighting ship should be and what I want to know is, what's wrong with the idea if anything? If there is nothing wrong with it, why on earth don't marine engineers quit building floating castles and put out some real, sure-enough fighting ships?

My conception of the most effective fighting ship is one with a beam of say 95 feet, a length of about 550 to 600 feet, a freeboard forward of 15 feet and a freeboard aft of 10 feet, mounting 12 14-inch 50-caliber guns in light turrets (the turrets just being heavy enough to protect the gun crews from the seas), each turret mounting three guns arranged in such a manner that the amidship turrets can fire over the fore and aft turrets, giving the ship six guns training forward, six aft and all 12 on the broadside. The superstructure should be very low, no higher than the midship turrets if possible and lower even if practical, the funnel or funnels should be as low as is practical and the side walls of the ship little if any heavier than those of the ordinary ocean liner of the same tonnage. The engines and boilers should be if possible even larger than those installed in the dreadnought of today of about the same fore and aft and beam dimensions and this ship should not display any "fighting tops" or observation platforms whatsoever. How then you may ask is the proper range to be secured, the gun crews to know whether their shells are taking effect, or at long range, how are they to know where the enemy is at all? The modern gun-pointer does not need to see his target to hit. He fires on orders most of the time anyhow. Shell spotting and range finding can easily be from small easily and quickly inflated and deflated balloons, one for each ship, attached to the ship by wire cables of say 1,000 feet in length and in touch with the bridge by telephone. If one cable is shot away, the balloon still remains on duty. Being anywhere from 700 to 900 feet above the water according to the wind and the consequent angle from the ship, the gun spotter and range finder are above the line of fire of the enemy if his own ship remains at her greatest maximum range from the foe, which her greater speed due to her lighter construction would enable her to do. At the same time the balloonist is close enough to his ship, even if the cables were laid out to a length of 1,500 feet to be amply protected from airplane attack by the anti-aircraft guns on the deck of his own ship. The anti-aircraft gunner who would let an airplane come close enough to damage a small dirigible balloon just large enough to support one man, when that balloon is only fifteen hundred feet or five hundred yards up, should go to the frigate for life and the man who rated him gun-pointer go with him.

Such a ship as the one above described should have a superiority in speed of at least six to eight knots over her more cumbersome enemy, if that enemy were built along the most approved dreadnought lines of today. The ship I have in mind would be just about four times as hard to hit as the ship of today for many a "skipping" shell would jump clear over her that would play havoc with the towering sea castles of today, she could pick her own range and constantly change that range to worry the enemy's gun and shell spotter. Her own shell spotter would have the advantage of a much higher "platform" and consequently be able to see more directly down upon the place his shells were hitting than the man who at best is not one-fifth as high as he. If things got too hot for this ship she could turn and run and "live to fight another day" when the odds might be more even. One thing is certain, she would be far less expensive to build than the towering sea-castle, and I for one would far rather be in her engine room in spite of the fact that she carried no practically useless armor than in the engine room of her far higher and mightier looking foe with all his fine armor belt that wouldn't stop a shell anyhow.

What is wrong with the type of ship I advocate and if there is nothing wrong with her, why is it that the marine engineer still sticks to the old, heavy armor unless it is that they are endangering the lives of the crews by building the heavy ship to get the "rake off" from the Steel Trust?

Hoping the SCIENTIFIC AMERICAN can answer my query or show me where in actual battle, my ship would fail or that some of the readers who are interested in marine engineering may be able to reply to my questions in an intelligent manner.

FRED VAN BLARCOM.

[*A ship of the type above suggested would have, we suppose a speed of 28 to 30 knots. If she possessed only 15 feet freeboard, as suggested by our correspondent, it would be impossible to drive her against a head sea of any weight; she would be drowned out and her forward guns could not be fired. The proposal to abandon armor and trust to a frequent change of course to dodge enemy salvoes, has been made by some eminent naval authorities. This is largely relied upon by the 32-knot ships "Renown," "Repulse," "Furious," and others, but they all have a lofty fore deck.*—EDITOR.]

Sir Hiram Maxim's Work in Aviation

To the Editor of the SCIENTIFIC AMERICAN:

My attention has been called to the article in your issue of October 4th on "The Romance of Invention—III." This article states that "The principle which they"—the Wright Brothers—"worked out was that of the warping wing," etc. . . . "With this, they combined the horizontal rudder," etc.

The warping or flexing of the wings of an airplane was patented by the late Sir Hiram S. Maxim. See his patent No. 10620 of 1897. "Improvements in aerial or flying machines."

In reference to keeping the machine on an even keel, I refer you to Sir Hiram Maxim's patent No. 19886 of 1890. "An improved method and apparatus for preventing or diminishing the rolling and pitching of ships or vessels."

Sir Hiram Maxim commenced his experiments in England on flying machines in 1888 or 1889. In 1908 he wrote a book entitled "Artificial and Natural Flight," which was published by Whittaker & Co. A copy of this book was sent to the editor of the SCIENTIFIC AMERICAN. In 1909 a second edition of this book was published and in the supplement due credit is given to the Wright Brothers for what they had done towards solving the problem of aerial navigation.

Although circumstances and conditions were such that no actual free flight could be made, nevertheless, Sir Hiram Maxim's big flying machine with its steam engine, condenser, etc., was the first machine, heavier than air, ever made to leave the earth under its own power.

In "Artificial and Natural Flight" full details are given of Sir Hiram's experiments.

In England it is admitted that Sir Hiram S. Maxim was a pioneer of flying machines and airplanes. This patent agent has told me that many little devices and inventions of Sir Hiram are used on machines of today.

S. MAXIM (LADY MAXIM).

London.

Research in the Paint Industry

By Henry A. Gardner

IT is rather interesting to note that the Orient has provided this country with several oils that are used extensively in the manufacture of paints and varnishes, and that the United States is not dependent entirely on its own or South American production of linseed oil for the making of these important products. For instance, during the last ten years a product known as Chinese wood oil (tung oil) has been used extensively in the United States and has been found vastly superior to linseed oil in the manufacture of a certain type of high-grade varnishes. Similarly, a product known as soya-bean oil, originally grown in Manchuria, has lately been adopted in the United States for application in the paint and varnish industries. The use of this oil, no doubt, will be of great interest to the manufacturers at this period when a shortage in flax has occurred.

The first serious shortage of linseed oil experienced in the United States was in 1910, when the flax crop failed in the Northwest, to which section its growth is restricted. Previous to this period, and, in fact, as early as 1907, the rapidly increasing demand for linseed oil for various purposes, led the paint manufacturers to give thought to methods for increasing the production not only of flax, but of other vegetable oils, such as soya. The latter was already being imported in small quantities and gave great promise as a paint oil. The flax shortage of 1910 stimulated this work, and a far-sighted campaign was at once inaugurated to study the question of domestic production.

Accordingly, a large quantity of soya beans was imported from Manchuria, and these, together with some varieties grown experimentally in the United States, were distributed at first to five States, where they were planted through the coöperation of the State Agricultural Experiment Stations. The active interest of the United States Department of Agriculture was enlisted in the problem, and with their aid, during the year 1913, practically every Agricultural Experiment Station in the country received and planted several varieties of the bean. As a result, information was obtained as to the varieties giving the most satisfactory yield and growth. In nearly every State successful harvests were obtained, thus demonstrating that the soya is a plant that could be grown not only in a restricted area, but in nearly every region of the country.

The southern portion of the country apparently afforded most excellent climatic conditions for growing the soya bean. Fortunately there are located in the southern states a number of cottonseed crushing plants, and, through their coöperation, the representative of the paint manufacturers' organization was able to have crushed considerable quantities of oil from beans grown in several districts. The cottonseed crushers' interest in this work was thus obtained, as the presence of an oil-seed crop other than cottonseed would make more continuous the operation of the crushing plants and the employment of labor. One ton of soya beans yields by expression about thirty-eight gallons of oil, the residue, a cake, being disposable for cattle feed at an attractive price.

Coincident with the above field investigation, extensive laboratory tests were conducted on oils expressed from a large number of varieties of the bean. A study of the physical and chemical constants of the oils was made and their practical adaptation for use in paints and varnishes was demonstrated. Methods of heat treatment to improve the body of the raw oil were developed, and a careful research into the efficiency of many metallic drying salts was conducted. With the data obtained from this work, paint manufacturers were enabled to apply the scientific principles necessary to use soya oil in place of linseed oil in the manufacture of paints. Large working batches of paints were prepared, containing soya oil alone and in various percentages with linseed oil. Some of these paints were applied to test panels and others were used under practical conditions on full-sized structures. Exposure of these paints over a number of years in different localities, including repainting tests, demonstrated that soya oil is a highly desirable paint oil when intelligently handled by the paint manufacturers.

The New York State Barge Canal—III

The Type of Barge Best Adapted to Our New Waterway

By Gordon P. Gleason

Rock cut on a long tangent of the Barge Canal. In all rock cuts the channel is 94 feet wide

WITH interest in waterway improvements aroused throughout the nation, the question of what type of boat is best adapted for use on our existing channels and projected improvements has assumed much importance among transportation authorities, and the need of a standardized barge has become so apparent that the United States now seeks to solve the problem. In European countries the need of standardization has long been realized. Accordingly France, Belgium and Holland, years ago, adopted the 300-ton barge drawing 5½ feet of water as a standard, while Germany whose waterways, prior to the war, were second to none, was operating on its canals and rivers standard barges carrying from 400 to 600 tons and drawing from 7 to 8 feet of water. In this country, however, there has never been any attempt made at standardization, with the result that we have had a motley collection of boats on our rivers and canals.

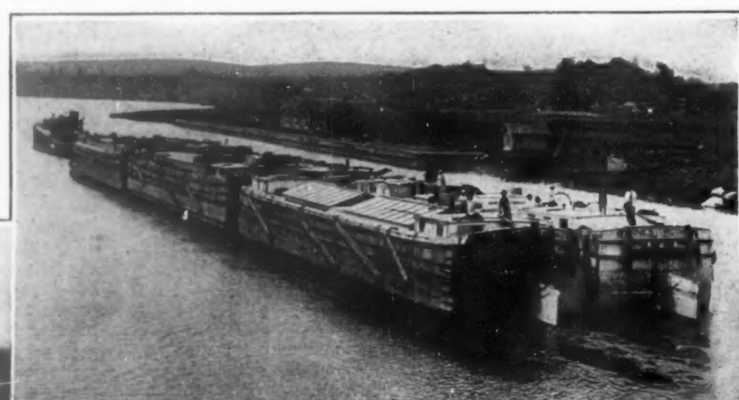
Now that we have a merchant marine, the relation of the inland waterway to our trans-oceanic lines can be readily appreciated. Furthermore, eminent authorities are agreed that waterway improvements afford the only relief we can obtain from the railroad congestion which has been and will continue increasing until some agency is provided to relieve it. Most of our projected waterway improvements such as the Lake Erie and Ohio River, Lake Erie and Lake Michigan and Lake Michigan and Mississippi River canals, call for a channel with dimensions similar to those governing the recently completed New York State Barge Canal. This modern canal with the proposed improvements in the Middle West, would give the nation a direct inland waterway system extending from the Atlantic Seaboard to the Great Lakes, Ohio River, Mississippi River and reaching into the industrial and productive centers of the nation. Thus, if present plans are carried out, there will be provided an inland waterway system having a minimum depth of 12 feet and a minimum width of 75 feet, the locks all having chamber dimensions of 310 by 44½ feet and a barge capacity of 3,000 tons. With such a system the standardization of barges should be a simple matter and, if brought about, would have a very healthy and economical effect upon our industries and foreign trade.

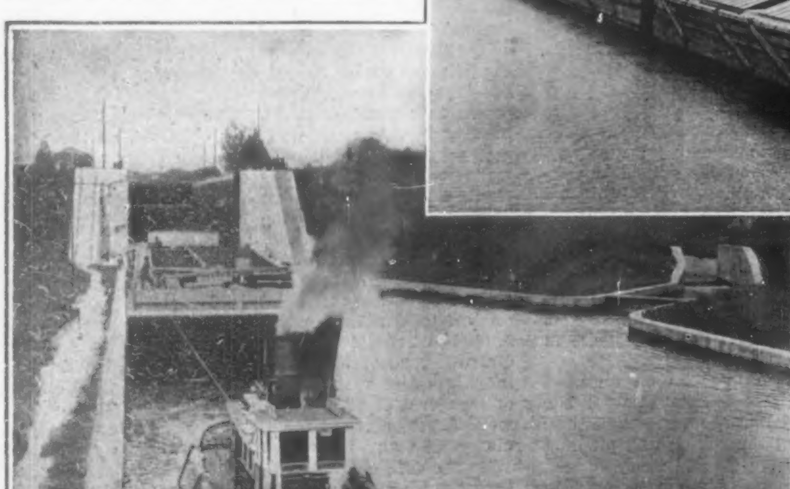
New York State authorities have been making a study of the types of boats best adapted for use on its canals. This study started in 1906 and, during the discussion of types which followed, a number of barges were advanced as combining all the elements necessary to the efficient and economic transportation of freight between the Great Lakes and Atlantic Ocean.

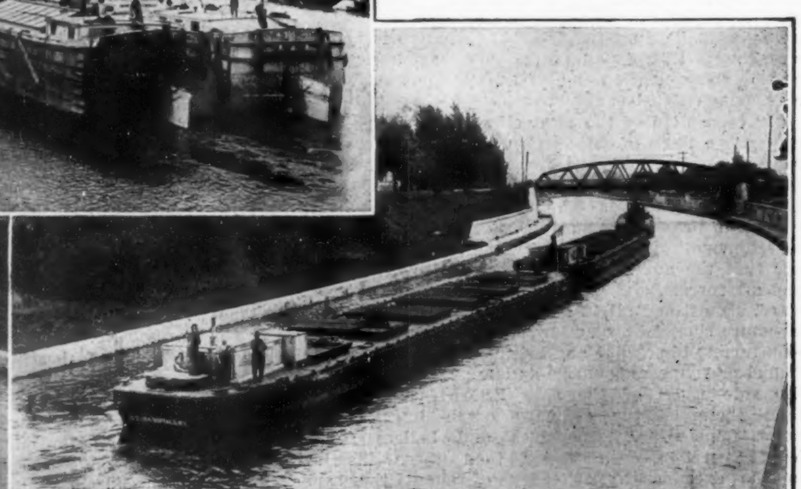
One of the first barges considered was a vessel 276 feet long, 40 feet wide and carrying 1,500 tons on a draft of 11 feet. A model of this was made by the Buffalo Steamship Company of Buffalo, New York, and, after considerable discussion, the type was discarded. Two reasons were given. First, the boat could not have passed another in the narrower parts of the canal. Second, but one barge could be locked through a lock at one time.

The Ohio steel river barge was another type advanced. This boat takes its name from the barges used on the Ohio River. These are 200 feet long, 36 feet wide and have a carrying capacity of 1,500 tons on a draft of 11 feet. This type found very little favor in the eyes of the state's authorities owing to its length and width and the fact that but one barge could enter a lock at a time. Furthermore, such a barge, because of its draft and width, would be forced to operate at a greatly reduced rate of speed in the more restricted sections of the canal. The cost of operating the barge under such conditions would have been excessive when the amount of freight carried is considered.

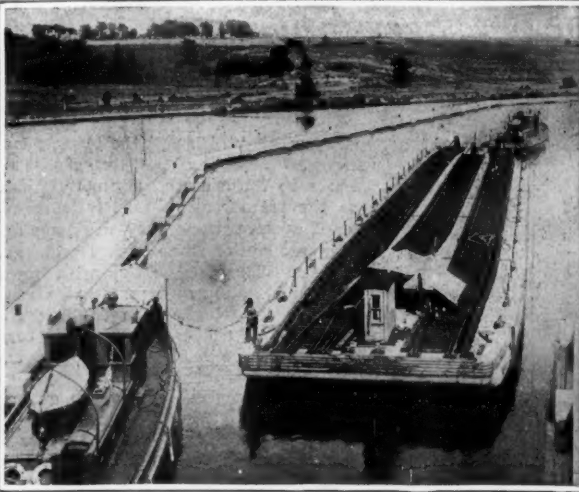
Shortly after this a group of men interested in establishing a barge line on the canal, advocated the utilization of the Delaware and Chesapeake Bay barge. These vessels are 210 feet long, 23 feet wide and have a maximum capacity of



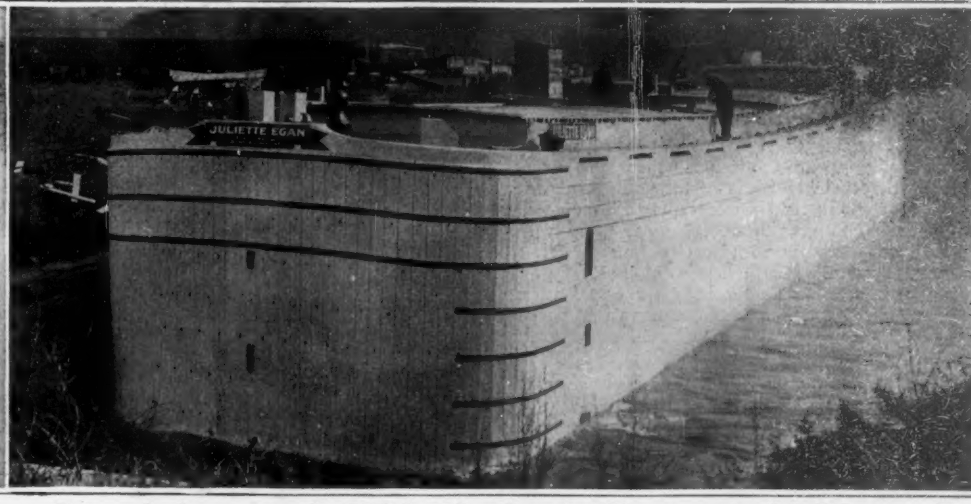




Left: Navy coal barge, 150 feet by 31 feet by 10 feet draft, en route to New York Harbor by way of the Canal. *Right:* Government 650-ton steel barges, carrying wheat from Great Lakes to Atlantic Coast. This will probably become the standard barge on our inland waterways. *Top:* Fleet of old Erie Canal boats in the new Canal. Only 200 of these left; they will soon be displaced by standardized barges, probably of steel or concrete



Concrete car float built on Lake Superior making its way through the State Barge Canal after crossing the Great Lakes



This wooden barge, measuring 110 ft. by 25 ft. and carrying 700 tons was recently built for use on the Champlain branch of the canal, not a standard type because two could not enter locks abreast

1,100 tons on a draft of 9 feet. One of the features tending to bring adherents to this type was the fact that it could be utilized on Long Island Sound and the Great Lakes as well as the canal, thereby placing Boston and other New England ports in direct water communication with the Middle West. Authorities questioned the value of this, pointing out that New York State had provided a modern public terminal system for the transfer of freight and that the insurance rates and crew cost on a barge operating in Long Island Sound and upon the Great Lakes would more than overcome the cost of transferring cargoes at the state terminals. Furthermore, the barge could not have utilized the full capacity of the locks.

Following the discussions over the Delaware and Chesapeake Bay barge, a boat was especially designed for use on the Barge Canal. This was to be self-propelled and would have had a capacity of 2,400 tons on a draft of 11 feet. According to the plans the boat would be 310 feet in length and 40 feet wide. The fact that such barges could not have passed each other in sections where the canal has a bottom width of but 75 feet caused the plan to be abandoned.

The so-called Danube River barge found favor with many. This boat is used in Europe with great success and is 200 feet long, 30 feet wide and has a capacity of 700 tons on a 10½-foot draft. It is provided with cranes and derricks for the handling of freight and was so equipped owing to a lack of suitable terminals along the Danube River, where it has been utilized. It was neither big enough to warrant its adoption on our waterways nor small enough to be successfully operated on our canals.

The all-steel German barge was advanced for consideration. This boat is in general use on German waterways and is standard. It is 178 feet long and 26 feet 3 inches wide, having a draft of from 4 to 8 feet and a capacity of from 400 to 600 tons. Only two of these barges, with a total capacity of but 1,400 tons could be locked through the Barge Canal locks at one time, leaving 1,600 tons of capacity to be utilized.

The Philadelphia steel barge, used on the Delaware River and capable of making short trips along the coast, was considered by those interested in the lumber trade. This barge is 210 feet long, 23 feet wide and has a depth of 17 feet and a capacity of 600,000 feet of lumber on a 9-foot draft. It, however, has the disadvantage of a high deck house which would have to be removed were it to operate on the Barge Canal owing to the bridges spanning the channel. It would likewise have left coniderable waste space in the canal locks.

The first barge actually constructed for the Barge Canal was the Occo-100. This is a wooden boat owned by the Ore Carrying Corporation of New York and is utilized to transport iron ore from Port Henry, New York, to Elizabethport, New Jersey. The Occo-100 is 152 feet long, 25 feet wide and has a maximum capacity of 1,000 tons. For general purposes the boat has been loaded to a draft of 10 feet and is used with a fleet of the old type of 240-ton Erie Canal boats, increasing the fleet's capacity from 1,400 tons to 2,000 tons and permitting a more efficient handling of the cargo.

Shortly after the launching of the Occo-100 the first official suggestion relative to barges for our internal waterways was made. This was contained in a statement by State Engineer Frank M. Williams of New York, who suggested that barges 150 feet long, 21 to 22 feet wide and having a capacity of 650 tons on a draft of 10 feet would be ideal. In pointing out the advantages of this type, Mr. Williams said that the boats could be moved in fleets of four, one being self-propelled and that the entire fleet, carrying a cargo of 2,600 tons could enter a lock at one time. The boats could also pass each other in the most restricted parts of the canal and would allow a water cushion of 2 feet between the bottom of the barge and the canal bed, eliminating all danger of crowding the bottom while operating at a rapid rate of speed.

Shortly after this suggestion was made a group of men, operating fleets of boats on the Barge Canal, planned the construction of ten steel barges. These were to be utilized for the movement of package freight and were to be 150 feet long, 22 feet wide and

(Continued on page 100)

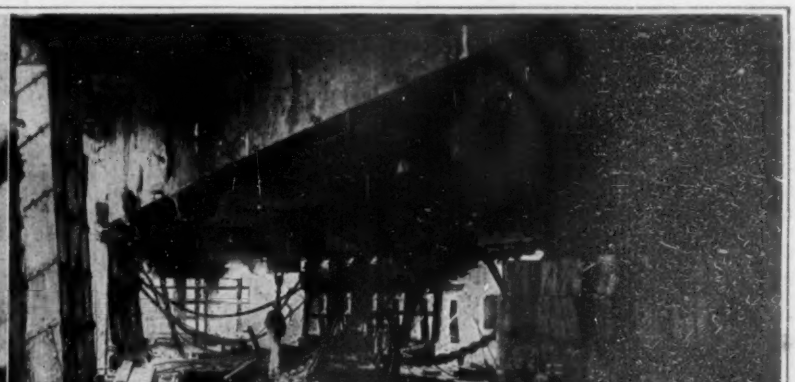
New Point of View of a Ship's Battery

SOME photographs of the salving of the battleship "Leonardo da Vinci" which are supplementary to those which we showed in a recent issue, have come to hand, and two of them are so striking that we venture to present them. Both were made after the battleship had been unwatered in dry dock. One of them was taken from a point forward, looking aft, on what would be the starboard side of the ship were she not upside down. It shows four of the anti-torpedo battery of 4.7-inch guns. These guns, as will be seen, are recessed inwardly from the side of the ship, each casemate being recessed sufficiently to permit of fire ahead, parallel to the longitudinal axis of the ship.

To the dockyard man the illustration is of particular interest as showing in detail the system of supporting bents employed and the points at which the great load of the ship was supported. To the right in the picture is the line of bents which is placed at the side of the ship where the massive internal frames meet the deck. The bents are built up apparently of 12" x 12" timbers with bottom and transverse sills and caps and inclined posts interposed between them. The bents are held in place by iron strapping, which is stud-bolted to each bent with a couple of stud screws.

In taking the other photograph the photographer has swung his camera around and pointed it toward the bow of the ship. On the right-hand side of the picture will be seen a timber crib upon which one of the barbettes rests. Forward will be noticed two sets of bents, one on each side of the bow, and a third bent placed transversely to the bow. Abaft of this last-named bent will be noticed the heavy anchor chains and other gear, hanging from the deck and the hawse holes.

The starboard 4.7-inch anti-torpedo battery of the "Leonardo da Vinci" as seen in the inverted position of the ship in drydock



Fore deck of the "Leonardo," showing, to the right, a barbette minus its turret, and the blocking below the same

The Tower Telescope

How It Works and Why It Is Necessary for Certain Purposes

By Joseph Mastella Le Grand

TOWER telescopes represent the latest mechanical design applied to instrument: for use upon the sun. With them are made direct photographs of the image of the sun, and photographic reproductions of the outer edges or rim of the solar body with its prominences, together with spectrograms which, when properly reduced, give a chemical analysis of the molten mass and incandescent gases constituting the sun. By use of the attachment known to American astronomers as the spectroheliograph, based upon the discovery of a method to use monochromatic light, the photographing, independently and without interference, of the successive layers of the solar atmosphere is permitted.

The telescope consists primarily of four parts: the coelostat and second flat mirror; the slit which cuts the light down to a narrow line; the dispersion apparatus which breaks up the solar light into its primary colors through the agency of the difference in wave length and refracting value, and the plateholder which carries the photographic plate upon which the final record is made.

The functions of the coelostat and second flat mirror are to collect the inclined rays from the sun and turn them on their downward path from the top of the tower to the apparatus below. The coelostat mirror is a flat disk of glass with a silvered surface, set in a cast iron water jacket to keep it at a constant temperature. Upon the water jacket casting are mounted trunnions from which the unit is suspended in a heavy cast iron frame, bringing the axis of the mirror parallel to the axis of the earth and upon the true meridian. Through a worm-driven sector attached to the upper trunnion a gravity clock drives the coelostat at a speed corresponding to the rotation of the earth.

The second flat mirror has for its function to collect the light cast upon it by the coelostat mirror and reflect it downward. It is mounted upon a vertical stand directly in front of the coelostat. This mirror is also surrounded by a water jacket and silvered upon its surface. Then of course in the top of the tower, a few feet below this mirror, is a lens which brings the parallel light from the mirrors to a focus upon the slit.

The slits are mounted upon the rotating bed of the spectrograph at the base of the tower. They consist of adjustable knife edges, V-shaped slits for sun-spot work, and many different combinations made to suit the great variety of work done on an instrument of this size. They are divided into the primary slits which are used for admitting light to the dispersion apparatus and the secondary slits used in connection with the spectroheliograph.

The dispersion apparatus is situated at the bottom of a pit or well sunk below the base of the tower. In the case of the 150-foot telescope at Mount Wilson, the dispersion pit is 78 feet deep, as the dispersion instruments must be 75 feet below the slit. Various combinations of prisms and mirrors are used as well as diffraction gratings. A frequent combination is two prisms and a flat mirror, or three prisms, and in some cases only one large glass or liquid prism equipped with the required mirrors. Gratings for certain classes of work are more desirable as dispersing agents than prisms; but on account of the enormous expense and the many mechanical difficulties involved in ruling them to a desirable fineness they are not in such general use on large spectrographs as they would otherwise be. The Mount Wilson Solar Observatory at a very considerable expenditure of money and energy has constructed a ruling engine for making these gratings. The light is dispersed by the prisms by refraction and by the gratings by diffraction. All optical parts used in the dispersion pit are mounted upon a cast iron stand on the concrete bottom of the pit and are controlled by the observer from the base of the tower through electrical devices. The entire telescope, in fact, is equipped with motors and solenoids connected to a keyboard at the base of the tower so that the observer may, by pushing different buttons, operate the coelostat, second flat mirror, and any of the lenses from his position at the tower's foot.

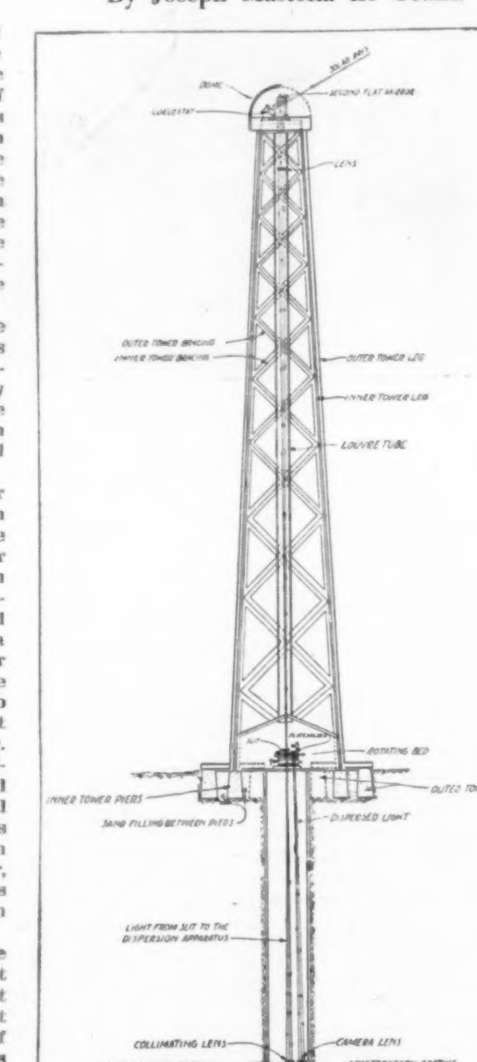
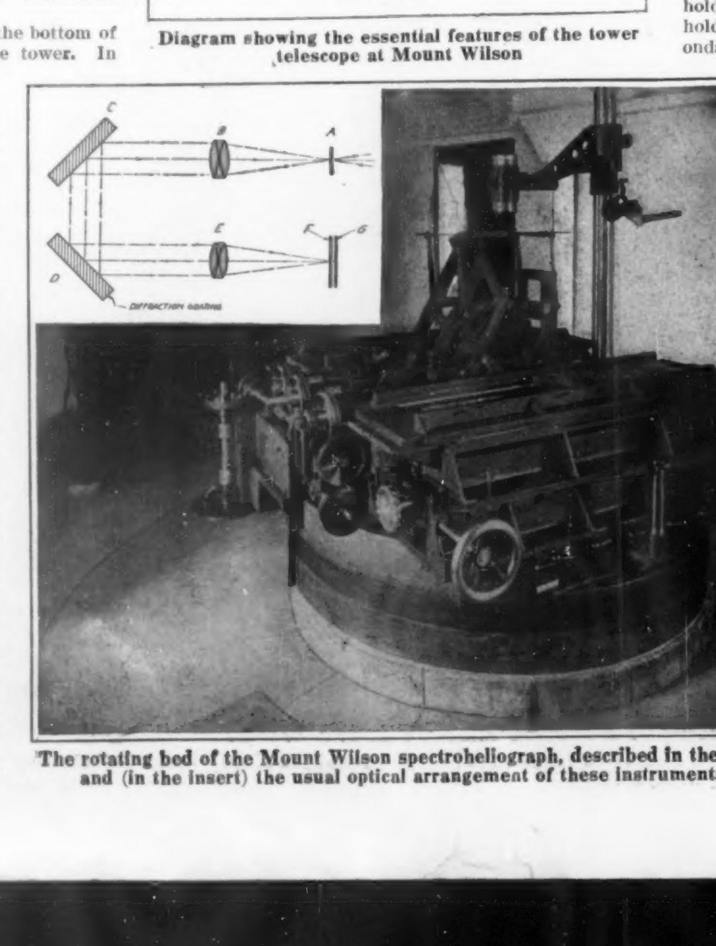


Diagram showing the essential features of the tower telescope at Mount Wilson



The rotating bed of the Mount Wilson spectroheliograph, described in the text; and (in the insert) the usual optical arrangement of these instruments

The plateholders of nearly all spectrographs are made very similarly to those of the commercial camera, except that the frames are generally of brass, and in the case of spectra work they are long and narrow, in some cases about three inches wide and eighteen inches long. They are fitted with metal back and the usual slides, together with brass cross bars supporting the back springs. The plateholder is carried in a sliding frame designed so that by turning thumb screws it can be made to travel in any direction.

Nearly all modern spectrographs have the spectroheliograph apparatus. When it is desired, for instance, to take a photograph of the calcium vapors on the sun the spectroheliograph is set on the calcium line. The primary slit, which is wide enough to extend across the entire image of the sun, is set in motion and travels across the solar disk, carrying with it the complete spectrograph with the exception of the plateholder, which remains in a fixed position relative to the solar image. The result is that all light from the sun is taken in and passed through the collimating tube to the dispersion apparatus. After dispersion it falls upon a camera objective which projects the entire solar spectrum upon the plane of the secondary or camera slit, which is directly in front of and adjacent to the photographic plate. But the slit is set upon the calcium line; so with the plate stationary relative to the solar image, and with the rest of the apparatus, being moved as a unit across the solar disk, there is built up upon the plate an image representing the sun in calcium alone.

The diagram reproduced shows the general optical arrangement of all spectroheliographs. "A" is the primary slit which intercepts the solar light; "B" the collimating lens which sharpens the field and makes the diverging rays from the slit parallel, projecting them upon the flat silvered mirror "C." "D" represents the prisms or other dispersion apparatus; "E" is a camera objective upon which the diffused light is thrown and by it the spectrum is projected into the plane of the secondary or camera slit "F." The photographic plate is indicated by the letter "G" and is immediately behind the slit "F." The collimating tube "B" and the camera tube "E" are optically alike, their functions being to render diverging light parallel, or vice versa.

The rotating bed of the 75-foot spectroheliograph at Mount Wilson appears in our photograph. In the center will be seen the primary slit with its worm-driven carriage. On the far side is visible the plateholder and clamping device; underneath this plateholder and driven by the worm wheel shown is the secondary or camera slit. The plateholder shown on the near side is the one generally used for sun-spot work. In the case of this instrument the primary slit and the secondary slit are driven together by worm wheels from the same worm, and the power, delivered through the grooved pulley from a small motor, is transmitted to the worm through a set of spiral gears. The dispersion apparatus in the pit below is fitted with synchronized motors which, operating through worms and sectors, keep the rays in alinement. The small instruments shown on the column over the bed are magnifiers and are used for sun-spot work. The upper part of the bed is mounted upon ball bearings in a V-race and may be rotated at will in either direction, allowing the observer to bring the slit across the image of the sun in any direction.

One of the important features of the tower telescope is the louvre tube through which the light passes on its way from the top to the base of the tower. In early experiments it was found that there was an appreciable difference in temperature and in the velocity of the air currents at different elevations in the tower and it was to obviate the disturbances from this that the louvre tube was introduced. It is essentially a steel tube covered with canvas louvres for its entire length. Therefore the beam of

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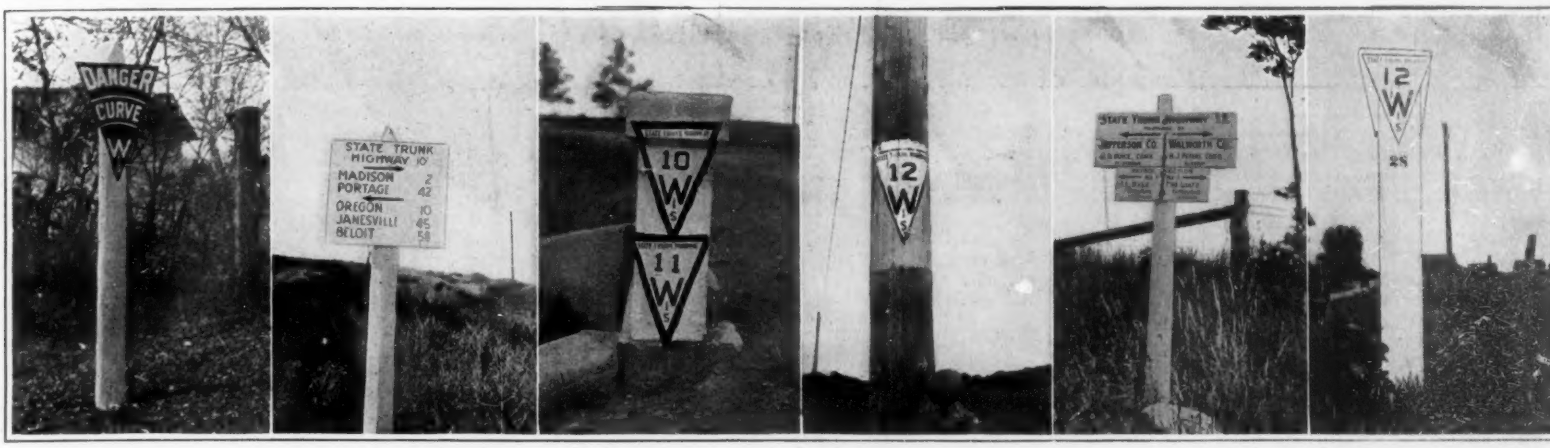

From left to right, these show the warning of an approaching curve; the two-way substitute for the old finger-post; the blaze on a culvert end indicating that two of the marked routes follow a common line here; blaze for a single route on telephone pole; general information sign at county line; and combined blaze and milestone on specially erected concrete marker.

Some standard Wisconsin highway markings

Blazing Wisconsin Ways

By Avis Gordon Vestal

IN earlier issues of the SCIENTIFIC AMERICAN (May 10 and June 14, 1919) I have discussed the desirability and the feasibility of marking our main highways to direct travel, promote safety and afford various valuable kinds of information. The widespread use of motor vehicles brings to all roads users from points hundreds, even thousands of miles away. In those preliminary surveys of the field I outlined some of the general principles for adequately blazing our motor ways, and illustrated them with examples of good work done by scattered communities or by privately-supported highway organizations such as our pioneer, the Lincoln Highway Association. During three summers of touring, covering about 15,000 miles in a dozen states, I have held an open notebook upon my lap and scribbled memoranda about the character of the roads and their marking as viewed (and felt!) by their "ultimate consumer." The existence or nonexistence of route marking and the fluctuating quality of the painted guide posts led me alternately into the lost and found classes.

Then came Wisconsin ways. In 1919 I saw for the first time a definite and detailed *plan* worked out with great care and backed by state authority while "fronted" with paint paid for by the people of the commonwealth. Five thousand miles of properly painted roadside symbols offer a sample sheet which all who motor may read. This is the mileage scientifically selected to be the State Trunk Highway System. Its courses touch some part of each of the 71 counties of the state, entering 58.6 per cent of all the townships, 96 per cent of the cities and 62 per cent of the incorporated villages. It is estimated that 81 per cent of the population is directly upon or very near to these routes. The mileage under state control will doubtless, in future years, be increased. The main transstate tourist trails crossing the state are linked up with these roads at the Illinois, Iowa or Minnesota borders.

When a "totem pole" in Iowa, for example, chances to designate several marked motor ways at once it resembles a rack holding all of Joseph's coats at once. The standard blazing adopted by neighbor Wisconsin is "Quakerishly" plain. I mean *plain* in a double sense. The colors are those of the printed page: jet black upon pure white, making a striking contrast and not easily dulled by sun and rain. A white background aids visibility not alone by day but also by night when touched by the rays of the friendly moon, the head or spotlight of a motor car, or a lantern of flashlight in the hand of a horseman or pedestrian who knows not "where he is at." The rule given to one who would motor along a trunk trail after dark is: "Look at your meter. Keep a light turned to the roadside. Within a mile you will pick up a marker or know that you have strayed from your path."

The standardized system of marking came from the State Highway Engineer's office in Madison. The application is made by the local road patrolmen, employed by the state, a part of whose duty it is to place, repair or repaint the symbols. The State High-

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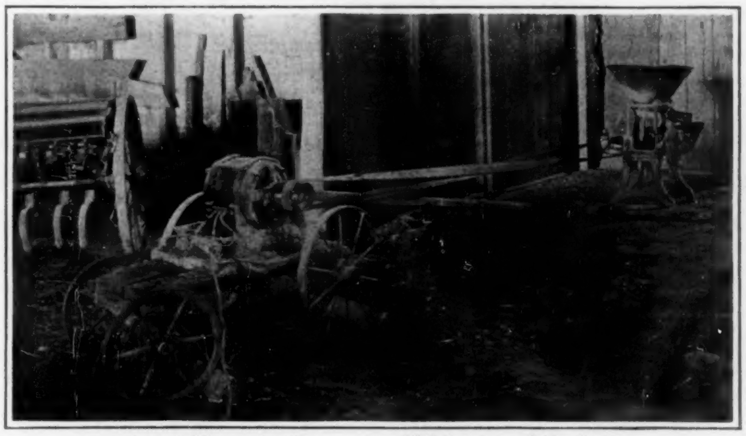

A portable motor for use on odd jobs around the farm

Hydro Power for the Canadian Farmer

AS far back as 1910, the necessity of serving rural districts with power for the farmers was recognized; but conditions in rural districts on this continent were realized to be radically different from what they are in the districts where such power has been applied in Europe. In the latter instances, farm buildings of different owners are assembled so as to form a hamlet, the inside power-using farm machinery being set up at a central point, and threshing, chopping and other work being brought to this plant. The particular feature that made it possible in these districts to have their power at a central point is the small farms and the intensive farming which is practiced on them.

In America on the other hand the first movement towards supplying power to rural districts was made by reason of the necessity for irrigation, the production of power and the delivery of water being worked out together. As a natural result, power being available for pumping and irrigation, the same lines would provide power for lighting and uses in the household, and for other purposes.

Several years ago the Ontario Hydro-electric Power Commission, appreciating the possibilities in the rural districts of the province through which hydro lines run, made demonstrations at different fall fairs and exhibitions, beginning at Toronto, of the uses of power in the household and its application to the driving of the farm machinery. Following up these demonstrations an actual working exhibition was made on the farm. A 5-ton truck was fitted with all kinds of agricultural machinery, such as milking machines, chopping mill, buzz saw, etc., for use in the barn and the different utensils for use in the house. In addition to this, a full-sized range was carried, a demonstrator cooking the meals for all the help engaged in threshing and silo filling at each point visited.

A syndicate outfit, consisting of a 25-horse-power motor with starter, mounted in one wagon, the necessary transformers for stepping down from the distributing voltage to a safe voltage for handling on the

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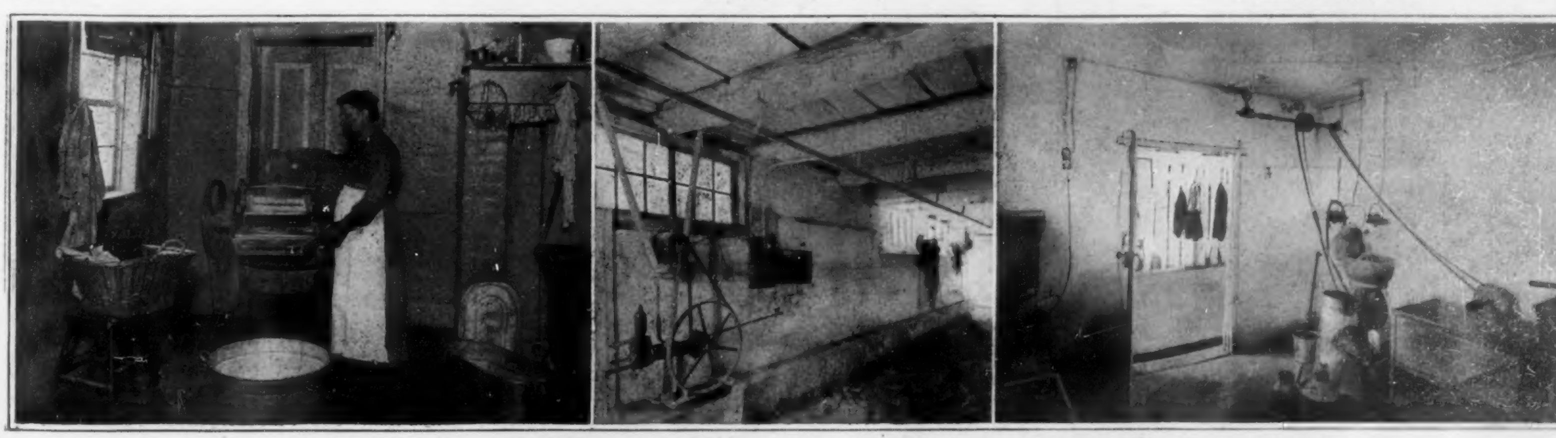


Left: **Running a washing machine off the lighting circuit.** ***Center:*** **Putting hydro-power to work in the barn.** ***Right:*** **The electrified dairy.**

How the Canadian farmers get the most out of the electric service

Wonderful Clocks of Olden Times

Striking Examples of the Work Done by Exponents of This Early Mechanical Art

IMAGINATION and inventiveness have been very active in the realm of watch and clock making for many centuries. Ever since men devised methods of telling time by the shadow cast by a tree or a mountain scientific minds have aimed to invent new means of recording time and to perfect old methods. Charlemagne marveled at the clepsydra or water clock presented to him by Haroun Al Raschid, and it was indeed ingeniously constructed. It was made of bronze, artistically gilded, and recorded the hours on a dial.

Even in those days this clock had a "striking" apparatus. Every hour a number of small iron balls fell on a bell and thus announced the passing of another hour. When the hour struck, moreover, twelve little windows opened and a knight came out, gesticulated, and disappeared within. In the old days, water clocks told the wrangling lawyer that it was time for him to cease all argument. A special official was appointed to watch the clock and notify the lawyer when his time was up.

Progress in horology went on, however, until some very wonderful time pieces were produced, including so-called automaton clocks, the most remarkable of which were made by Swiss clock makers. Noteworthy among these were the productions of Pierre Jacquet Droz, 1727-1790, and his son Henri Louis Droz, 1752-1791, of Chaux de Fonds, near Neuchatel.

The recent visit of the Prince of Wales to this country recalls the fact that the collection of clocks owned by his grandfather, King Edward VII., was particularly remarkable, and he prized them very highly. Even more interesting than this, however, was the collection of the belligerent Hapsburg family, which comprised clocks of every description, including many having great intrinsic value on account of the precious material of which they were made and the number of precious stones used, rare automaton clocks and astronomical time pieces, the complicated features of which have always aroused considerable interest both among laymen and scientists. A few of the interesting clocks of this collection, which for many years reposed in the art historical Court Museum in Vienna, are illustrated herewith.

At the right is an automaton clock, made in the early part of the 17th century and measures 14 inches in height. It is surmounted by a watch in a case of oriental jasper and shows in striking relief the portraits of the Saviour and the Virgin Mary. A miniature garden with animals and plants and a mower swinging a scythe are shown within the glass case containing the mechanism. The figure with the scythe is connected with the clock works, and goes through the operation of mowing quite naturally.

Next comes a very interesting time piece as it shows one of the first pendulum clocks ever made. The two dials seen in the illustration are attached to a pedestal of agate adorned by four circlets of garnets. The dials on the right and left are inserted in oval cases. The covers of the watches are made of rock crystal embellished with plates of smoky topaz. The watch on the left indicates the minutes and the hours which, together with the quarters, are announced by an intricate striking device. The clock work for the quarters is arranged at the left, that of the hours at the right. This is really a calendar clock, the large hand of the watch on the right pointing to the days of the week, while the little hand points to the phases of the moon. On the inner part of the dial the signs of the Zodiac are engraved. This artistic time piece was produced in the early part of the 17th century by one Justus Byrgi, at Prague. Byrgi is believed by many to have antedated Huyghens in the application of the pendulum as a means of regulating clocks. Byrgi's birthplace was in the Canton of St. Gallen, Switzerland, about the year 1551. He had scant educational advantages in youth, but by dint of energy and hard work, coupled with an innate special aptitude for mechanics and mathematics, became famous as an artist and a scholar. His fame began about the time he was called to become court mechanician for William of Hess. When the latter died, Byrgi was appointed Chamber Clockmaker to Emperor Rudolph II., at Prague, and held this post until his death at Cassel, January 31, 1632. His favor with the Emperor was greatly increased by the invention of a celestial globe which he presented to Rudolph. He was also the inventor of various mathematical instruments.

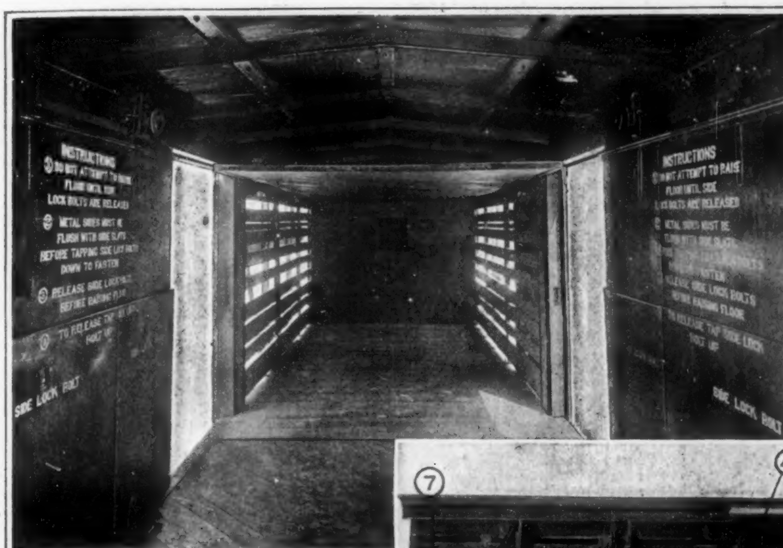
A complicated hanging clock in silver and enamel from the 1600's

A man who achieved great fame as a maker of odd clocks was John Trebler, of Friedberg, who made the unique clock next toward the left. This clock is 26 inches high, and is made of ebony, ornamented with silver and ivory. Six columns of silver support the cupola, which is surmounted by an eagle, rather formidable in aspect, and bearing on its breast the Order of the Golden Fleece and the Austrian shield, in which the letters F 3 (Emperor Ferdinand III.) are engraved. A well-known physical apparatus known as Heron's fountain is comprised in the clock and is set in operation by the clock mechanism. Trebler resided in Augsburg in the 17th century. In this same city, in 1564, lived J. Metsker, who built a complicated clock (at left) that is quite artistic in design and ingenious in construction. The clock is made of gilt copper and is surmounted by a figure standing on a ball. The top part of the clock itself is embellished by a relief design by H. S. Behan. The large dial just under this design, it will be noted, has two hands. One hand marks the minutes and the other the hours. The outer circle of the dial is divided into two twelves, while the inner circle is a straight 24-hour dial. This dial contains, moreover, a disk for the alarm, and also a double disk to indicate the length of the days and nights, as well as the hours, which have passed since sunset—that is, the hours of the day for those nations which reckon from the setting of the sun. There is a mechanism above this dial to stop or start the alarm. The rate of the clock is regulated by the small dial just to the right of this large dial. Below, on the left is a disk containing the calendar, consisting of three plates placed one above the other, each side of which represents two months. These are made to revolve by the mechanism of the clock work every 60

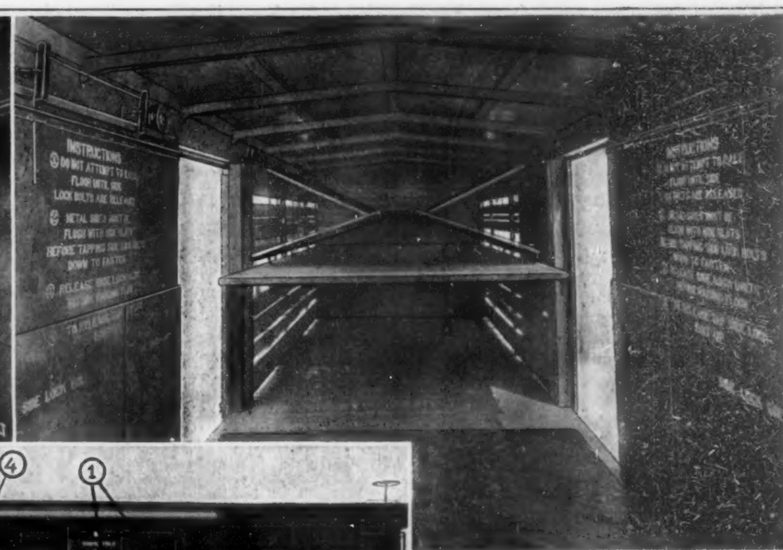
(*Continued on page 104*)

Left: A complicated clock made at Augsburg in 1564. *Left center:* Automatic clock with heron's fountain from the seventeenth century. *Right center:* One of the first pendulum clocks from the seventeenth century. *Right:* Another handsome design of the seventeenth century.

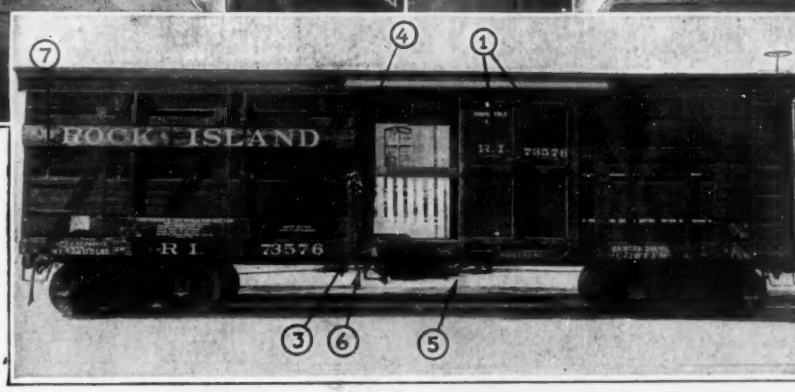
Four early clocks of distinctive lines and g.eat present value



Interior view of the convertible car, with far end ready for live stock



Near end converted to box car and converting device in mid-position at far end.



Exterior view of car with converting device installed

A convertible car that can carry live stock one way and general merchandise on the return trip

A Convertible Railroad Car

ONE of the most difficult problems to be solved in railroad operation is the elimination of empty car miles—hauling empty cars. A great portion of such mileage is due to the transportation of live stock—from the ranches to the great stock yards—because of the special type of car required for such traffic. Heretofore it has been an impossible task to find suitable freight to load in such cars on their return trip to the stock raising country. This results in an immense loss in nonrevenue car miles and because large numbers of stock cars lie idle for a great part of the time.

A convertible car, designed to carry live stock in one direction and—by adjusting certain parts—to carry general merchandise on the return trip, has been developed by a Texas Company. This device may be applied to any stock car now in service or may be built into new cars. Its installation is not difficult and its operation is so simple that a car so equipped can easily be converted from a stock car to a box car by a station agent or other railroad employee without assistance from the mechanical department. Complete instructions appear on the inside of the car.

As shown in the illustrations movable sides and floors, operated by means of a ratchet crank, from a worm and sector device located under the car, permit the conversion of the car from one type to another.

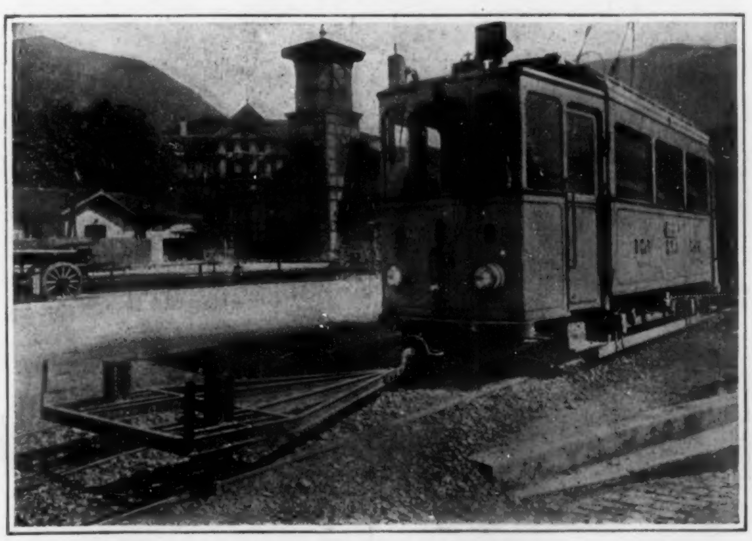
To the ratchet crank and to the four corners of each section of a 2-inch pine floor is attached a ⅜-inch steel cable which runs over sheaves inside of the car. To convert from a stock car to a box car it is only necessary to turn the ratchet crank and the movable floor—suspended near the roof while the car is in use for live stock—is lowered into place, on top of the permanent car floor. The steel sides are hinged horizontally and being connected to the movable floor are automatically drawn downward and against the slatted sides of the car where they are secured by side lock bolts. The car may then be loaded with the same class of merchandise that is carried in the ordinary box car and hauled to the stock raising sections of the country where the process is reversed and the car again converted to a stock car. No part of the movable floor or sides ever comes in contact with the live stock.

This convertible device is in successful operation on one of the largest live-stock-carrying railroads in the United States and has demonstrated beyond doubt the great economy to be effected by its use.—*C. N. Winter.*

Rail Cleaner for Street Car Lines

THE street railroad, by virtue of the fact that its rails frequently lie flush with the pavement, is more subject to interruption of traffic through the ravages of ice and caked snow than is the steam line, with its upstanding rail. In addition, the street-car rail frequently has a groove which offers an excellent resting place for obstructions. To avoid this sort of thing, it is in fact necessary on many lines to maintain a track inspection and rail scraping service, quite independent of what may be called for in the direction of formal snow-sweeping when a regular storm comes along. Those who are served by underground trolleys, with contact made as it is in the New York system, through a slot in the ground, will recall the somewhat analogous situation when it becomes necessary to halt traffic while the slot is thawed out.

With the object of reducing the amount of labor required in the clearing of ice, caked snow and dirt from the rails, the apparatus depicted in the photograph herewith was recently tried out on a Swiss interurban line. It proved to be extremely efficient, and is expected to render the greatest service during the cold part of the year. The apparatus is in large part a rake adapted to use on the rails. It has, in lieu of the row of teeth, two strong, sharp spikes, fixed on to the framework on either side. These are spaced the distance between the rails from one another; they enter into the grooves of the rails, and as the car moves forward they effectively remove all obstructions.



A drag for keeping trolley rails clear of ice and other impedimenta

Pickling Machine Operated by Air

A PICKLING machine used for cleaning the surface of metals with chemicals has been brought out by a Pittsburgh company. Its novel feature is that it is operated by air. The machine is of steam-driven type and consists of a vertical reciprocating plunger with a spider of three or four arms, carrying crates which move up and down in the pickling and rinsing baths. It owes its origin to the problem arising in a Braddock, Pa., mill, which found it impractical to use steam as a driving medium, as all power purchased is electric, such steam as is generated being of low pressure for heating purposes only. The installation of high-pressure boilers within the limited space available would have meant considerable trouble in the quick and successful operation of the plant.

For these reasons the company, with the coöperation of the makers of the pickling outfit, decided to try the use of compressed air. Some apprehension was felt on account of the probable high rate of air consumption in a machine designed to be steam driven; also exhaust steam, originally designed for heating vats, would not be available.

In order to produce greater economy, it was decided to use that type of pickler which balances practically all dead load by compressed air instead of by counterweights. In cases where balancing has been done by counterweights the results were not satisfactory because on the down stroke the unbalanced weight is the only moving force, thus resulting in sluggishness of operation. When using compressed air for balancing purposes the bottom end of the piston rod, with its load, floats on the compressed air; thus the operating piston is relieved of lifting the dead load at every stroke and greater economy of steam and air is obtained. Changes were made in the parts and valves to preserve the speed of piston operation of the steam-driven machine. The steel casing which surrounds the piston rod is buried in concrete, holding the machine rigid.

When operated with two loaded crates, the machine used 20.7 cubic feet of compressed air per minute while running at 32 strokes per minute. When loaded with one crate, the machine used 19.6 cubic feet of air while running at 30 strokes. In the former case, the air pressure at the machine was 87.1 pounds per square inch, whereas in the latter case it was 82 pounds.

In the test with two loaded crates, the indicated horse-power of the machine was 6.06, while the ideal horse-power, which might have been obtained from the compressed air by expanding it without any loss for the atmosphere, would have been 13.8. The steam-pickling machine uses approximately 35 boiler horse-power. From the comparison it is evident that the introduction of the balancing feature has made compressed air economical.

Inventions New and Interesting

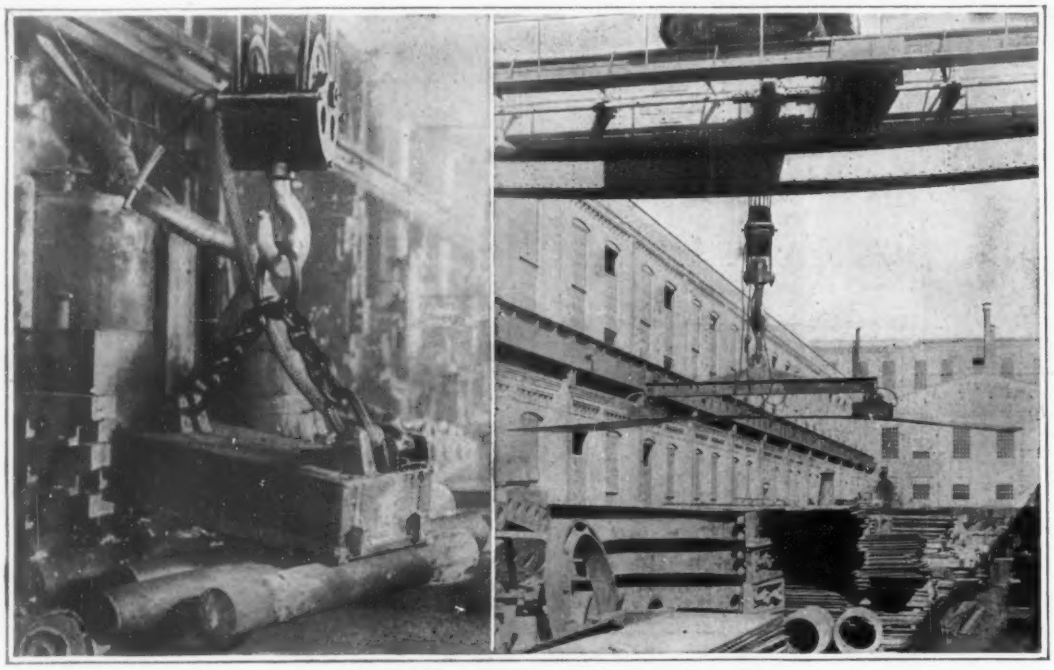
A Department Devoted to Pioneer Work in the Arts

Rectangular Lifting Magnets

THE rectangular magnets have been perfected for the more efficient handling of regular shapes in steel and iron. In the big steel mills, boiler works, valve and locomotive shops these single, twin and triplet magnetic Samsons of industry are making good. For severe service such as in the handling of scrap and pig iron where the magnet is dropped with a heavy blow down on to the pile this design is not to be recommended, as the coil shields are of brass in place of manganese steel and consequently could not be expected to withstand the hard handling in such work.

In construction the body of these magnets is a single steel box-like casting. It contains the magnetic coil and in the middle of the casting is a projection forming the inner pole, the other outward pole is the walls of the casting itself. The ends of the body part are well protected with heavy ribs which make possible the withstanding of heavy blows to which this particular part of the magnetic workman might be subjected.

When the rectangular lifting magnet is used in pairs it is mounted on a spreader bar, the flexibility and the length of the load determining whether such a bar is necessary. Plates six feet long if very thin may require two magnets to handle efficiently while rigid bars thirty feet long can be handled by a single magnet.—*K. H. Hamilton.*



Two views of the rectangular lifting magnet at work

Branding California Walnuts

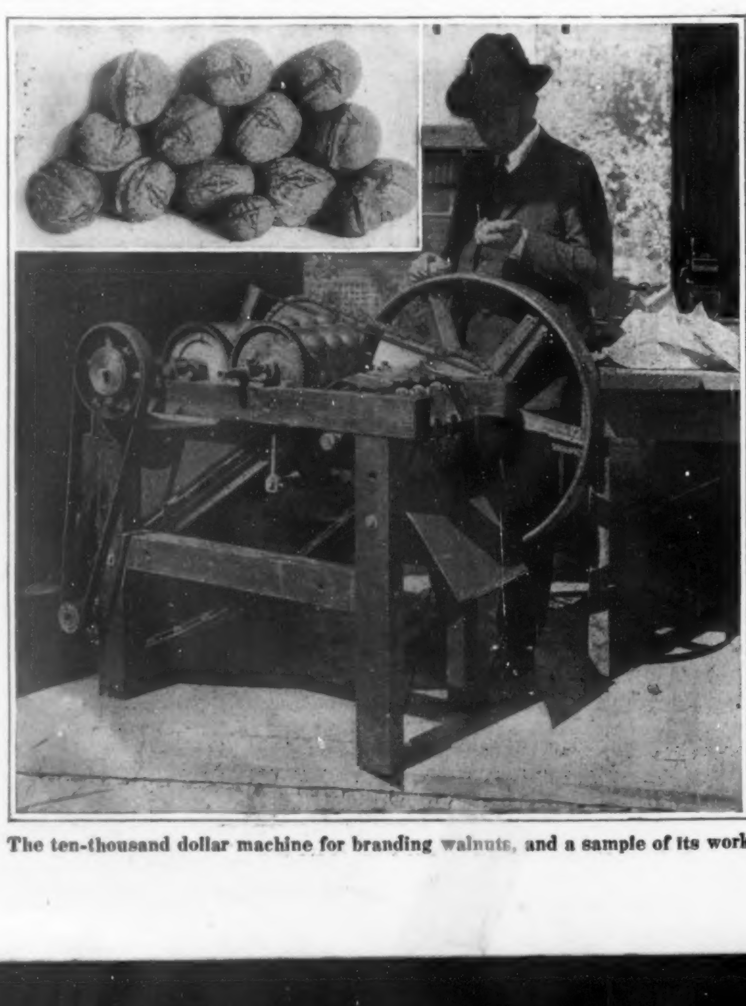
THE California Walnut Growers' Association has finally chosen from the thousands of ideas offered by contestants for the $10,000 prize, a machine which when perfected will place its trademark on the shell of every walnut. When it is considered that nearly twelve thousand replies came in response to the prize offer appearing once, last April; that about eleven hundred sent in working drawings and blue prints; and that one hundred and twenty-seven contestants submitted actual working models, it will be seen that the Association had no small job in selecting the best machine.

The models operated upon a number of different principles, the most common being the marking of the walnuts by various rubber stamp contrivances. Some employed the air brush working through stencils, others used electrically heated dies which burned the brand into the shell and a few fell back on the old reliable action of centrifugal force and gravity. The machines which did the best work however were designed along the lines of the offset printing press and it is upon one of the latter that the Association is pinning its hopes.

The inventor of the successful machine is Mr. A. S. Wysong of Los Angeles, Cal. While the prize has not yet been definitely awarded to Mr. Wysong, he has been granted time to perfect his model and build a full size working machine. If this machine when completed proves to be of the required capacity and will operate within the limits of expense fixed by the Association, the inventor will be awarded the prize in return for delivering to the Association patents covering its use on walnuts.

Mr. Wysong's machine employs several novel features not found in the other models of the offset type. It consists of a steel cylinder in the surface of which are engraved the branding dies. This cylinder rotates in a bath of quick drying ink at the lowest point of its revolution and the excess ink is scraped off by a knife edge about half way up. The steel cylinder is engaged positively with a second cylinder of the same size which carries firmly, in pockets on its surface, rubber covered balls of soft composition material similar to that used for the inking rollers of a printing press. These balls are so placed that each comes into direct pressure contact with its corresponding engraving on the steel cylinder, receives the impression of the trademark and transfers it to the shell of the walnut after a further quarter revolution. The walnuts are fed into a hopper the bottom of which is formed by a moving link belt arrangement which carries one walnut in each of its pockets to a positive engagement with one of the rubber covered balls bearing the inked impression of the die. As the balls are soft and resilient, they conform readily to the rough surface of the shells and carry the brand into the very cracks and over the sharpest ridges of the nuts.

These rubber-covered balls are so placed in sockets that they can be turned to present many different surfaces if one should become worn. The material from which the balls are made is prevented from heating and softening during operation by an ingenious system of continuously circulating cold water forced through the hollow cylinder, which counteracts the effect of the heat generated by the friction. The distinct advantage which this machine possessed over many of the others was that every walnut was certain to be marked with only one brand and that this trademark was especially clear and legible.—*H. H. Warner.*



The ten-thousand dollar machine for branding walnuts, and a sample of its work

Latest Patent Decisions

Deliberate Infringement:—The suit herein grew out of alleged infringement of patent issued to Albert De Laski and Peter D. Thropp, assignors to the De Laski & Thropp Circular Woven Tire Co. The Miller Rubber Co., defendant appellant, denies both invention and infringement. A preliminary injunction was granted, and later the case was tried in open court upon its merits. This resulted in an opinion and decree adjudging validity of the patent as to the claims in the suit, and their infringement; and also in the present appeal. The invention relates to a tirewrapping machine. Before this suit was commenced, appellant had purchased of appellee one of its make of tire wrapping machines and is still operating it. Appellant had also purchased from Wm. R. Thropp & Co. a tirewrapping machine which appellee claims was like the infringing device in the suit before this one, and appellant had also caused to be constructed, and is still using, two tirewrapping machines which appellee maintains were built in accordance with the patent in suit. The last three machines are the basis of the charge of infringement. Held, that the De Laski & Thropp patent is infringed by the use of a machine purchased by, and of two machines built for, it. The point of law is that where the evidence warrants the conclusion that the infringement of a patent involved in the construction and use of machines by defendant was purposeful and inexcusable.

(Continued on page 104)

Some Vegetable Parasites

(*Continued from page 87*)

before putting it into the seed pans. In this way the fungus will be destroyed. One method of dealing with rose-mildew is to spray the tree with "flowers of sulfur" by means of a pair of powder-bellows.

The first application should be made before the time for the white, powdery "summer fruit" to appear. There are also a number of patent fungicides with which the tree may be syringed.

The Board of Agriculture has made the spraying of potato crops well known to the British farmer; nevertheless, the grower of potatoes may be interested to know that this "Burgundy Mixture" consists of blue vitriol (copper sulfate) mixed with soda and water, while "Bordeaux Mixture," also used for the same purpose, is made from blue vitriol, quicklime (calcium oxide) and water, but in order that these mixtures may not be injurious to the plants, they must be prepared with the utmost care. It should be remembered, however, that it is largely the conditions under which a plant is grown, which decide whether or not that plant is to be healthy.

The variety of types of vegetable parasites mentioned above is by no means exhaustive; there are even fungi parasitic on fungi. Sufficient, however, has been said to show that we have, in the vegetable parasites, a very real and dangerous enemy, the study of which is full of interest.

Romance of Invention—VII

(*Continued from page 88*)

waters and then to London for the electrical exhibition held there in the early eighties, that his real electrical career began. Made secretary of a jury of awards on electrical apparatus, the young officer, in the face of orders to report elsewhere, completed a report on electrical matters which saved him from what might have been a deserved court martial, and established him not only with his own government, but with many famous men of science abroad, as an intellectual and scientific force with large potentialities. Bitten deeply by the electrical microbe, Mr. Sprague obtained a year's leave and resigned to become associated with Mr. Edison, with whom, however, he remained less than a year.

Into the merits of a one-time controversy between these two gentlemen as to who did what, it is not the province of this story to go. Mr. Edison's fame as an inventor and as the father of the incandescent electric light system is secure, and so recognized by Mr. Sprague—but the latter is as entitled to the term "father of electric traction," in its modern development, though he would be the first to disclaim any attempt to saddle himself with the "invention" of moving a street car by electricity. What he did of great importance while with Edison was to establish the field of mathematics in the electrical installation field. In the early days of electric lighting, an installation was made largely by rule of thumb, and the mains and feeders experimentally determined. Sprague worked out the mathematics of the thing, and indeed, obtained a basic patent on the proportioning of the supply of feeders and distributing mains.

The lighting side of electricity seemed to the young scientist to be pretty well taken care of. The power side of electricity, then utterly undeveloped, appealed at once to his imagination and his business sense, . . . and Mr. Sprague has always been a good, if radical, business man. Hence, his devotion of much time to the development and invention of electric motors, and the exhibiting in 1884, of the first, practical, constant-speed, non-sparking motors.

But to produce a practical motor was one thing . . . to get it introduced into industry was quite another. Steam was the great prime mover. Bolts and shafts were as much a part of manufacturing plants as buildings and material. Either to substitute a motor for the steam engine or many motors for the belts and shafts seemed equally hopeless.

Nevertheless it was done, and the Sprague motor gradually forced its way into industry. With every lathe and planer in big factories today moved by electric motors, with the clean, quick power and the absence of effort-absorbing transmitting machinery of any modern factory, it seems strange that industry did not then embrace the new idea with open arms and at once—but it is the history of a thousand inventors that they must fight for recognition and plead for trial, and the industrial electric motor was no exception to the general rule.

The first Sprague Company, formed when Mr. Sprague resigned from Edison's employ, had a paper capitalization of a hundred thousand dollars, of which sixteen shares were sold for cash, and of which company Mr. Sprague was vice-president, general manager, chief inventor, treasurer, salesman, bookkeeper and office boy. Yet the young company made headway from the start, and in two years had put two hundred and fifty Sprague motors into operation. It is a curious sidelight on the state of the industry at this time that the early catalogs contained names, addresses and letters from owners of Sprague motors to demonstrate to the curious and incredulous that an electric motor would actually run.

Meanwhile, Mr. Sprague was turning to the application of motors to railways, to which he had already given much thought while on duty in London in 1882 to 1883, and if the interests involved had not been so great—think of this nation today without electric railways—the early history of electric transportation would read almost as a farce. Street railroads and elevated roads alike would not even listen to a man who claimed to be able to better service, increase schedules and reduce costs with an electric motor. Jay Gould, who visited an experimental track on which a motor-equipped car was operated by Mr. Sprague for a few hundred feet between the walls of a sugar refinery, was so badly frightened by the failure of a safety catch and the resulting small electric volcano, that he was never again interested in electric installations.

But there were others with vision beside Mr. Sprague. Superintendent Chinnock of the Edison station, acting for the president of one of the Edison companies in New York, offered the young inventor thirty thousand dollars for a sixth interest in his company. Sprague turned down the offer, in spite of poverty. He was gambling with the future and believed in the value of his invention. Later he sold a twelfth interest through the same man for twenty-five thousand dollars and another twelfth to someone else for over twenty-six thousand dollars. It is reported that the first purchase was made on spiritualistic advice! This was following a demonstration arranged for Cyrus Field, on an elevated track, in which the work of assembly was done between a Saturday morning and Monday night, and the car presented to Field's inspection without a single test to determine whether wiring and switches were correctly arranged or not. But they were, and for two hours young Sprague demonstrated things with an electrically-operated car, which railroad men had said couldn't be done.

But still New York interests fought shy of the new idea, and the first Sprague electric road contract was in St. Joseph, Missouri (except for single cars operated experimentally by storage batteries in 1886 to 1887) followed by the historic installation at Richmond, Virginia, the parent line of all modern trolley lines.

(*Continued on page 99*)

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Of General Interest

HEEL.—G. C. Seymour, 18 East 49th St., New York, N. Y. An object of the invention is to provide a heel arranged with a rubber or cushioning section which is removable and a clamping section therefor utilizing the resiliency of the rubber as a locking spring, the construction being such that the bottom of the heel is inclined toward the bottom of the shoe more especially in the back, thereby increasing the height of the heel at the point of greatest impact, and affording a longer wearing action to the resilient member.

OIL CAN TOP.—W. A. Schmidt, Lewistown, Mont. This invention constitutes an improvement over that covered by Patent No. 1,195,102 issued to the same inventor August 15th, 1916. Among the objects is to improve the arrangement and control of the pour-out valve so as to make the same more reliable in practice and more easily manipulated. Another object is to provide means for more easily and delicately controlling the frictional adjustment of the valve actuating means.

GAS MASK.—N. Schwartz, 15 Ft. Washington Ave., New York, N. Y. The object of this invention is to provide a gas mask more especially designed for army and industrial use, and arranged to enable the user to breath freely without danger of inhaling noxious gases with which the surrounding air is charged. Other objects are to eliminate dead or exhaled air at the mouth and nose portions of the mask, and to insure proper vision and to prevent noxious gases from reaching the eyes.

TAG HOLDER.—S. J. Agnew, Box 1042, San Diego, Cal. An object of the invention is to provide a tag holder of extremely simple construction, which securely holds the tag in proper position, and which has extensions strengthening the lower gripping jaw and also performing the function of limiting the movement of the tag in tag holder.

PICTURE FRAME.—M. Loewenthal, 1133 Broadway, New York, N. Y. The object of the invention is to provide a picture frame having means for securely fastening the members of the frame in cooperative relation. The frame when constructed has a plurality of side members, each of which is provided with a face flange and an edge flange. These flanges are formed in perpendicular arrangement each to the other. The face flanges are cut to form mitered corners, and corner plates are used for uniting the frame sections.

CANOE TENT AND COT.—R. D. George, 4341 Tracy Ave., Kansas City, Mo. The object of the invention is to provide a device wherein a canoe is provided having means for permitting the same to be utilized to provide the roof of a tent, and in addition supporting flies, for forming

A PERSPECTIVE VIEW OF THE CANOE USED AS A TENT

the wall of the tent and capable of being folded into the canoe, together with a folding cot, which together with the supporting means for the canoe may be clamped within the canoe when not in use.

VEGETABLE CUTTER.—B. G. Illinger, 1118 Fulton St., Brooklyn, N. Y. The invention relates particularly to devices for use in delicatessen establishments for making potato and other salads in which boiled vegetables are used. Among the objects is to provide a utensil of a relatively cheap and yet reliable nature, that is particularly adapted for slicing vegetables having a relatively soft consistency, the cutting portion being sharp enough to reduce the commodity acted upon, yet dull enough to prevent cutting the fingers of the operator.

DETACHABLE TOOTH COMB.—E. H. St. Clair, 338 Abbott St., Detroit, Mich. The invention relates particularly to combs constructed in such manner as to permit of the teeth being detached from the body portion for the purpose of cleaning or repairing. The primary object is to provide a comb wherein there is a body portion and removable teeth, and wherein there is provided means for holding the teeth rigid and in proper alinement and spaced apart the required distance.

COMPOSITION TILE.—R. W. Schweimler, and P. A. Poulalion, Glenfield, Pa. The invention relates to composition tiles for floor and partition construction, each tile being formed of nail penetrating material, each tile having its side walls provided with ribs, a facing of plastic material filling the spaces between the tiles, and a nailing rib formed integrally upon each tile extending transversely across the bottom face thereof.

PENCIL HOLDER.—L. L. Lefler, Hayti, Mo. One of the principal objects of the invention is to provide a pencil holder which will allow the pencil to be used up almost entirely, even though

A LONGITUDINAL SECTIONAL VIEW, SHOWING SMALL PIECE OF PENCIL

the pencil is too short to be comfortably held in the hand. A further object is to provide a holder which will be extremely simple, durable, and inexpensive to manufacture.

RIFLE.—G. L. Henderson, 45 W. 1st North St., Salt Lake City, Utah. The invention relates to magazine hand firearms, its object is to provide a rifle having an exceedingly simple operating device. Another object is to provide a rifle for use by cavalrymen, mounted police and other persons, and arranged to permit of readily placing the rifle in a saddle scabbard. Another object is to prevent accidental firing of the gun or failing to return the operating lever to full closed position.

SIDEWALK LIGHT.—A. C. Crimmel, address Sneath Glass Co., Hartford City, Ind. The general object of the invention is the provision of lights or transparent tiles for sidewalks, pavements, vault covers, floors and the like. A further object is to provide a non-breakable transparent tile or light which may be expcsed to the varying influences of temperature, and which may be used in substitution for the single piece glass tile, and be readily set in place in any form of frame made to hold the usual form of vault light.

JAR OPENER.—J. C. Armor, 97 Lenox Ave., Pittsfield, Mass. An object of the invention is to provide a construction of clamp which will cause the effectual release of a cover from the jar no matter how tight it may be adhering to its gasket. A further object is to provide a device in which the clamping member is made with a shield, against which the movable jaw of the operating device is adapted to contact and prevent possibility of breaking the neck of the jar.

HAIR WAVING APPARATUS.—A. J. Zirgen, 3464 Broadway, New York, N. Y. The object of the invention is to provide a hair waving apparatus arranged to insure the production of a permanent Marcel wave by means of moisture and heat, in a very simple manner, and without danger of injury to the hair. Another object is to provide a simple heating apparatus for producing different degrees of heat, completely under the control of the operator, to prevent overheating, and thus injuring the hair.

DRYING PLANT.—Marie P. P. Gloess, St. Mandé, France. The invention has for its object to provide a vertical drier which permits a scientific and systematic drying of the material to be treated, the drier is characterized essentially by the method of circulation of the air, or of the hot gases employed to remove the moisture from the materials to be dried.

TREE FELLING DEVICE.—S. C. Rosenberg, First National Bank Building, 42 Church St., New Haven, Conn. The general object of the invention is to provide means to be used in lieu of an ax or a saw in felling a tree by subjecting it to a burner arranged to embrace the tree to burn an annular zone thereof, and to be constricted as the burning process and the tree is proportionately reduced in diameter at the zone.

FRAME FOR FILTER PAPER.—A. M. Vaughan, 901 N. 5th St., Richmond, Va. The invention relates to a frame for shaping and holding filter paper. The device further aims to provide a holder in which the paper may be applied in the form of a blank, and upon the grouping together of the holding frame the paper will automatically assume the position required for the proper filtering of fluid.

DEVICE FOR DEVELOPING ROLL FILMS.—C. L. Bambrick, Brooks, Alberta, Canada. This invention relates to devices for holding films while being developed or fixed, and has for its object the provision of an automatically adjusted device for holding the film comparatively taut without creasing so that it may be placed in the solution substantially at the same time, and held therein without any chance of sticking to supporting members.

AQUARIUM.—W. Mack, 2193 Broadway, New York, N. Y. The object of the invention is to provide an aquarium which is simple and durable in construction and not liable to get out of order. Another object is to render the aquarium watertight. The construction comprises a metal base with annular flange, glass sides seated against the frame flange, and, corner clips fitted exteriorly onto adjacent ends, fastened by bolts.

FISH HOOK.—A. Sobanski, 1252 Burrard St., Vancouver, B. C., Canada. The invention relates to fish hooks of the kind in which a plurality of barb points are movable relatively to each other in order to secure an effective grip upon the fish. The device is provided with a spring arm, the shanks having two different normal positions controllable by the pressure of the sprong arm upon a cross portion.

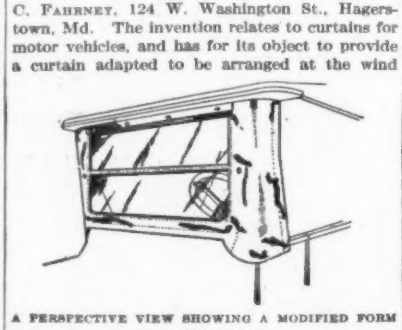
CLOTHES PIN OR CLAMP.—P. Townley, 409 River Ave., San Antonio, Texas. The invention relates more particularly to a metal clamp to not only take the place of the ordinary wooden clothes pin, but to go beyond the same in clamping qualities and durability, the object being the provision of a simple inexpensive clamp consisting of a single loop of spring wire embodying two strands. By the use of rust-proof wire all danger of marring or staining the clothes is avoided.

Pertaining to Recreation

TOY AIRPLANE.—G. Sochurek, 55 6th Ave., Astoria, L. I. This invention relates to toys and has for an object the provision of a construction which is adapted to be supported by a movable cable or support and arranged to move back and forth over the support, the arrangement being such that the toy will turn as it reaches the end of its travel in either direction.

Pertaining to Vehicles

CURTAIN FOR MOTOR VEHICLES.—E. C. Fahrney, 124 W. Washington St., Hagerstown, Md. The invention relates to curtains for motor vehicles, and has for its object to provide a curtain adapted to be arranged at the wind



A PERSPECTIVE VIEW SHOWING A MODIFIED FORM OF CURTAIN

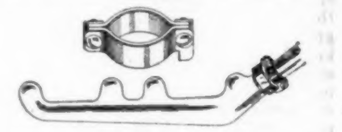
shield to cover the space between the shield and its supports, and between the shield and the body of the vehicle, and between the sections of the shield to prevent the entrance of moisture at the front of the vehicle.

VEHICLE WHEEL TIRE.—T. C. McEwen, 20 Beach Street, Belleville, N. J. The object of the invention is to provide a vehicle wheel tire provided with an armor interposed between the shoe and the inner tube to protect the latter. Another object is to permit of conveniently and quickly placing the armor in position in the tire for use or removing it whenever it is desired to change the shoe or the inner tube. Another object is to render the armor exceedingly useful in tires which have been in service for some time or in an otherwise useless tire.

AUTOWAGON.—A. Korgan, R. F. D., No. 2, Council Bluffs, Iowa. This invention relates to tractors and more particularly to means which may be applied to vehicles and automobiles to provide tractors which may be used for hauling trucks or other like vehicles. The object is to provide means whereby an automobile may be converted into a tractor for hauling trucks or wagons, and readily restored to its original function.

PORTABLE LIQUID DISTRIBUTING APPARATUS.—W. K. Shelly, Decd., address Tiffin Wagon Co., Tiffin, Ohio. The invention relates to distributing apparatus designed for flushing and sprinkling streets, but capable of use as a fire fighting machine, for flushing sewers, for spraying trees and for other purposes. The object is to provide a power-driven vehicle having a tank and apparatus arranged to maintain a constant pressure on the liquid, or to increase or decrease such pressure as desired, regardless of the apparatus traveling along. A further object is to permit of readily converting the apparatus into an ordinary auto truck.

NUT CLAMP.—H. A. Haskell, 12 Summer St., South Braintree, Mass. The invention relates to a form of nut clamp, particularly adapted for use on "Ford" cars, and other automobiles for preventing any rotational movement of the nut upon the screw threads of the exhaust mani-



SHOWING AN OUTER ELEVATIONAL VIEW OF AN EXHAUST MANIFOLD AND PIPE WITH COUPLING SUIT, AND NUT CLAMP

fold, or pipe, and providing a positive locking means between the exhaust pipe, or manifold and the nut serving to couple the two together. The invention contemplates a clamp which is simple, and of such rugged construction as to eliminate any question of the same breaking.

MOBILE FIGURE.—M. Sieveking, 418 Central Park West, New York, N. Y. The general object of the invention is to provide a figure constituting for example a cap ornament for automobile radiators so arranged as to result in a movement of parts which in the case of a bird, for instance, will more closely approach the natural movements of the wings, and whereby the mobile parts will be so sensitive as to readily respond to slight, while at the same time the structure will possess durability.

DEMOUNTABLE RIM HOLDER.—J. P. Jacobs, Shelbyville, Tenn. This invention relates generally to vehicle wheels and more particularly to a demountable rim, and has for its object the provision of a holder arrangement capable of manipulation from a single point to either lock or release the rim in respect to the wheel filly, instead of the individual manipulation of an annular series of rim holding lugs. This device automatically centers the rim with respect to the wheel.

TRANSMISSION BAND.—H. F. Hons, Jr., 324 Clipper St., San Francisco, Cal. The invention has reference more particularly to breaking means used in connection with automobile transmission. An object is to provide a brake band that can be easily put in a car and which may be shifted up and down allowing the band to slip around within the transmission case with to slip around within the transmission case with ease, and which will retain its original and normal shape and size. Another object is to provide a band made up of removable parts.

TIRE-BUILDING CORE AND CHUCK.—P. and B. De Mattia, Garfield, N. J. The object of the present invention is to produce a collapsible core so constructed as to provide an increased or greater freedom of movement of the collapsible sections to facilitate their more complete withdrawal from the pneumatic tire shoe which has been constructed thereon.

Designs

DESIGN FOR A COMBINATION CAKE MIXER, BEATER, TURNER, SIFTER AND MEASURING SPOON.—Rose C. Hamill, Oakland, Md.

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Romance of Invention—VII

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Mr. Sprague says today that this contract was one no sane man should ordinarily have undertaken, since it involved a complete generating station, overhead lines and feeders, the equipping of forty cars with eighty motors, to run on twelve miles of track, the contract to be completed in ninety days, and the payment, one hundred and ten thousand dollars, to be made "if satisfactory." Yet Sprague knew that if he could do it and it was successful, it would be a demonstration which would put the electric traction idea definitely on the map.

So he did it, and, referring to this enterprise, a commentator once said: "When Sprague invaded Richmond in 1887, resolutely plunging into a pool of difficulties from which only unceasing fertility of invention and tireless industry could extricate him, he awoke the world of transportation to an acknowledgment that the electric railway, though an infant, had a future."

Followed great success, and so much buying of so many motors, that a merger of the Sprague Company with other interests seemed the wise thing to do. It would never have been done had Mr. Sprague known that his name was to be arbitrarily removed from every piece of electric apparatus and another substituted, or that the attempt would thus be made to deny him who had for so long struggled to put his idea over, the credit which was his due. But Mr. Sprague spends less time crying over spilled milk (should one say spilled motors?) than most people, and dived headlong into the application of electricity to elevators, forming the Sprague Electric Elevator Company and beginning a new flight.

Here, as usual, the gambler's spirit of "risk all on a good chance" led Mr. Sprague to guarantee to his first principal customer, John Mackay, of the Postal Telegraph Company, that he would either succeed with six electric elevators in the new Postal Building, or scrap them and replace them at his own expense with any make of hydraulic elevators he might choose.

Here, curiously enough, occurred the incident which led to the development of one of Mr. Sprague's greatest contributions to industry and science—multiple-unit system of train control. He had connected all six of his electric elevators to one control switch used for testing purposes and was sending them up and down the shafts together, when soon afterwards the idea came to him "if elevators from a master controller, why not cars?" True, the elevators were all running at different speeds and bobbing up and down in a haphazard and somewhat dangerous manner, but that was a detail. The idea of having each car of a train equipped with motors and controllers and then assembling the cars at will into trains and controlling the controllers from master controllers at either end of any car was then and there born.

It is a long way from birth to maturity, however, and again it was not New York and the then but-proposed underground railroad interests which tried out the new idea, but Chicago, and the South Side Elevated. Again it was one of those risk-all, get-all, or lose-all contracts, in which Mr. Sprague guaranteed certain performances under a penalty of rejection and "no pay" if he failed. To complicate matters, he had to go to London to try to get the contract for the deep lifts of the then but-starting Central London Tubes (which he did get, a half million dollar contract, once more because he was perfectly willing to guarantee results or waive payment). But somehow he managed to close one contract while planning details of another across the ocean by cable, and later succeeded in filling both, having his multiple-control

do all and a little more than he claimed for it in increasing speed and control and thus allowing more cars per mile of track.

Then came the contracts for the Brooklyn and Boston Elevated, and finally the absorption of his company by a larger one. The story of the adoption of what is now known as the Sprague-General Electric multiple-unit control would take volumes and need hours for its reading. But the inevitable end came at last, and today Mr. Sprague can ride in trains controlled by his invention in New York, Boston, Chicago, Berlin, London, Paris and a host of other places, and has the satisfaction of knowing that without this system of control there could be no such thing as subways on their present basis of large carrying capacity, and that upwards of a hundred million of dollars must have been saved the city of New York alone by using it in place of the at first projected locomotives.

As one of the members of the Commission which supervised the electrification of the New York Central terminals, Sprague was largely responsible for the decision made as to that equipment, especially for the adoption of direct current for operation, and has ever been prominent in the controversies which raged with regard to electrical systems. The story of his persistent fight for the use of high tension direct current in electric railway operation, against deep and vested financial interests, is a romance in itself. But his views seem to have won out, for according to the report of the French Technical Commission, the Chicago, Milwaukee and St. Paul Railway, now operating at 3,000 volts for hundreds of miles over the Continental Divide and the Cascade Mountains, is the most important and successful of all electric trunk line installations.

If a man may ride in thousands of elevators, all electric, and say to himself, "I did it!"—if on any one of tens of thousands of miles of trolley lines he can have the comfortable feeling that both the motor which drives it and the conception of operation were originally born in his brain, if on dozens of elevated and underground roads he can realize that it is *his* system, *his* invention, which makes quick starting, long trains, quick stopping, small headway, and consequent large number of trains per mile possible, it might well be considered reasonable if said man should stop and draw breath and decide he had done enough. But Mr. Sprague is not the stopping and breath-drawing kind. He loves a fight too much for its own sake, and an active brain which has spent its life first in evolving and second in forcing the results of such evolution upon interests which had to have them and didn't know it, is not content to stop.

Mr. Sprague believes firmly that automatic train control is something which must come on main line operation, that the present-day idea, which makes the only connection between the wayside block signals and the engineer a visual one, is radically defective. He points to the many grave accidents which have occurred because of the failure, not of the signal system, but of the engineer to see, understand or obey the signal, as proof that the weak link is too weak for modern high speeds, short blocks and crowded tracks.

Hence he has devised and for several years has been engaged in perfecting a system by which automatic train control is made to completely supplement manual control. The unique thing about this system is the elimination of mechanical contact between engine cab and signal, and the fact that the control of the train is only taken out of the hands of the engineer *when the engineer makes a mistake.* If he sees and heeds the signal the train is left entirely under his control as in the present system, but if he goes to sleep on the job, or sees and does not heed, or does not see, the automatic control takes hold and brakes the train for him.

Of the details of this Mr. Sprague is not willing to talk except to railroad and Government officials. But he is as firmly convinced of the need of such a system and of the capabilities of it, as he ever was of the future of motors, electric cars, elevators and multiple-train control, and it would surprise no one if he offers to equip some large railway division with automatic control and bet the price of his contract against the judgment of the incredulous officials of the road—and wins out in doing it.

Mr. Sprague has many patents to his credit, here and abroad, but does not take out patents except when he considers the object sufficiently important. He has been really more prolific of new ideas, subject to patent, than almost any inventor now before the public. Unlike many who have obtained many patents, Mr. Sprague's several lifeworks speak for themselves, in electric installation the world over, of the success and practicability of his ideas.

His success has come entirely from hard thinking, plus hard fighting, and his career cannot help but be an inspiration to all those who have invented what they know to be good, and suffered some of the discouragements which so often come to the pioneer.

"If you want something, ask for it," says Mr. Sprague. "If you can't get it by asking, fight for it. If what you have to offer is good, it will win in the end. But it will win against prejudice and inertia only if you believe in it, work for it and fight for it."

The New York State Barge Canal—III

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have a draft of from 6 to 9 feet. Each boat would be self-propelled and carry from 400 to 600 tons of freight.

The outbreak of the war, however, resulted in a lull in barge building operations and no barges were constructed until the latter part of 1918. At this time the United States Government, which had early in 1918 taken over the operation of all barge and boat lines on our inland waterways, announced that fleets of steel and concrete barges were to be constructed by the United States for use on our waterways. These boats very closely followed the dimensions suggested by Mr. Williams, each steel barge being 150 feet long, 21½ feet wide and having a maximum capacity of 650 tons on a 9½-foot draft. This type of barge has been accepted as standard by government and other authorities and a large number of them are being built in various sections of the country. Over 200 of them are to be constructed for use on the Barge Canal and 76 are now operating upon that canal system.

There are two departures from the general rule, however, and these are the concrete barges, which have been constructed as auxiliaries to the steel fleets, and the steel tank barges which independent corporations have placed on the canals. The concrete barges are all 150 feet long and 21½ feet wide but carry only 500 tons. They, however, cost but $30,000, and can be constructed in three months, while the steel barges cost $60,000 each and take from 6 to 8 months to build. Despite the fact that the concrete boat carries less than a steel barge with like dimensions it has proven itself better adapted than either wooden or steel boats for the movement of heavy and bulky commodities such as iron ore and pig iron.

It cannot be said that all barge construction is being limited to the 650-ton steel barges or the 500-ton concrete boats. Barges of wood, each 110 feet long and 23 feet wide with a draft of 10 feet are being built at a number of yards for independent operating companies. At the same time a number of steel tank barges with varying dimensions are being con-

structed and are in use on the waterways. However, as traffic on the waterways increases and new projects are undertaken, it is assumed that all boat builders and transportation companies will realize that a standard barge is a necessity. On the other hand, experience will prove that there are certain types of boats better adapted to the movement of distinct types of freight than are the standardized boats. This, however, is a matter that will in no way interfere with the standardization of general freight carriers and, those familiar with the problem, believe that the new 650-ton and 500-ton barges will become the standard on American waterways.

The Tower Telescope

(*Continued from page 92*)

descending light does not pass through several temperatures of air and other atmospheric disturbances, but through a body of air of almost uniform temperature.

Probably the most interesting feature of the Mount Wilson installation is the construction of the tower itself. It will readily be seen that it is practically impossible to construct a steel tower nearly 170 feet high upon a mountain where high winds are common and where the air is very seldom still, and expect to project through it for a distance of 150 feet a beam of light which would be steady enough for photographic work. This problem was solved by the design and construction of two separate and independent towers, each resting upon different foundations, and one incasing the other member for member throughout the entire construction. By the use of these two towers it was possible to mount the dome and support the louvre tube on the outer tower and allow the inner tower to carry only the coelostat, second flat mirror, and other optical parts in addition to its own dead weight. In this way the inner tower, being relieved of the wind load, became a very light and simple affair, its members being constructed entirely of steel angles. It was supported upon four small concrete piers which were insulated from the piers of the outer tower by sand packed between them, thus reducing to a minimum the amount of vibration transmitted from the piers of the outer tower. The outer tower, carrying the hemispherical dome, was constructed of box members built of plates and angles. The legs of this tower were supported by steel beams which delivered the load of the tower upon concrete piers located several feet distant from the inner tower piers.

The spectrograph pit under the tower is ten feet in diameter and seventy-eight feet deep. It is sunk entirely in a granite formation and lined with concrete. A spiral steel stair was also constructed from the base of the tower to the bottom of the pit in addition to a small freight or dummy elevator. After the construction of the tower a passenger elevator cage was also added. This elevator is a small affair however and runs up the outside of the tower.

Blazing Wisconsin Ways

(*Continued from page 93*)

way Commission supplies stencils and printed directions for carrying out the plan uniformly along all five thousand miles alike. The original blazing was done in about a week by the effective cooperation of the employees in all the counties, the cost being about $9,000. It was found that 1 gallon of thick white lead and oil paint would spread 18-inch white bands, each with two coats, on 60 poles. In different localities the cost varied with the degree of care taken, the complexity of the roads, and with the portion of their length coming within city boundaries. The highest county rate per mile was $5.25; the lowest, $1; the average, $1.70. While the Trunk Highway System comprises but 5,000 miles the marking aggregates 5,300 miles, because in

some cases two or more roads follow a common course for a distance requiring duplicate or triplicate symbols and because the marking is continued through all cities, although the streets in municipalities of over 2,500 population are not a part of the system and not state-maintained. Careful and full indications through cities can hardly be over-emphasized. It is estimated that the addition of all the special signs to be mentioned later brings the total cost of the signs to $25,000, or $5 per mile.

Each state road is designated not by a name, but, as is a railway train, by a number. In Wisconsin an arbitrary decision was made that the numbers should be alike in having two digits, hence all below 10 are omitted entirely. The lowest number used is No. 10 which is applied to the longest of all, that from Beloit, on the southern border, to Superior, in the far northwest corner, with a mileage of 456. No. 11 is next in length, while the shortest road bears the highest number of all.

To facilitate following these roads or a course comprising portions of several of them the state prints maps in two sizes and sells them at cost through the Superintendent of Public Property at Madison. They are also sold through stores and merchants are allowed to add a small profit to the retail price. A wall map for use on hotels and garages is drawn upon a scale of 6 miles to the inch. The small map, a folder within a 16-page booklet of interesting facts, sells for a dime. It shows not only the trunk roads but also the secondary highways, the railways, and points much visited by tourists—parks, state institutions, and places of industrial, scenic or historic fame.

The standard symbols or pole markers serve two purposes: to identify the route to the transient and to designate it in road record-keeping. An inverted isosceles triangle, 10 inches wide at the top and 13 inches long, is outlined in coach black upon a white band 18 inches wide. Across the top is printed "State Trunk Highway." Beneath, in large numerals, is the road number, while the tip carries the signature of the state's abbreviation. These symbols appear at least every mile and sometimes in between. Telephone poles are utilized when possible but boards may be attached to trees or to specially-set short poles where no other support exists. The ends of bridges, culverts, even large boulders may bear the marks. At turns the white band is widened to 30 inches and a large "R" or "L" is stenciled beneath.

Mile-markers of wood, the entire standard whitened, are placed just outside the construction and maintenance limits to be within the range of the headlights of motor cars. They are set edge to the highway and numbered upon both faces, the mileage being reckoned from the south or east extremity of the road. They cost about $1.50 each, erected, and are valuable in definitely locating spots where faults exist or repairs are being made.

The third form of regulation marker is the oblong direction board at important road intersections. "On system" boards refer to towns upon the trunk highway, while "off system" placards direct to places to reach which tourists must depart from the marked way they have been following and use secondary roads for the remainder of the journey. About 2,000 direction boards have already been set.

Public recognition of excellent upkeep or of neglect of duty by responsible officials is a valuable bit of psychology. It makes the workers take a pride in what they do. Travelers often send in reports of praise or blame, using individual names. At the county limits appear the names of the counties and the names and addresses of the county highway commissioners. At the boundaries of the subdivisions, the local patrol districts, the names and locations of the patrolmen can be read.

Several forms of protective marking are used. The ends of culverts and bridges are whitened and where culverts are not guarded whitened stones or posts may be used to outline their margins. Special danger designations of metal are placed near schools, railway grade crossings or treacherous hills or curves. These cost about $1.38 each, exclusive of the labor cost of erection.

When these roads are blocked for construction or repairs the local patrolmen are expected to provide, mark and keep in order a temporary route around the obstruction. Waterproofed white paper posters bearing the word "Detour" are provided by the state, all ready to be nailed up after adding the numeral representing the route to which they are to play proxy.

Hydro Power for the Canadian Farmer

(*Continued from page 93*)

farm, the metering equipment and the main control-switch mounted in another wagon, was first put into service in Toronto Township, August 28, 1912, and afterwards used on different farms throughout the province, finishing in Elgin County near St. Thomas, the middle of November. A second similar power outfit was put into service September 14, 1912, the object being to increase the number of places at which demonstrations could be made and also to take notes by way of comparison with the steam and gasoline engines that are found doing threshing and silo filling on the farms of the province.

In May, 1914, six of the progressive farmers in Waterloo Township, having investigated the application of electric drive as used on West Oxford farms, decided that they too wanted a syndicate motor outfit to do their heavy work and made application to the Commission for an estimate of cost of power as well as the cost of an outfit. They had their own steam engine which was in good working order, but after receiving the estimates decided that it was possible to substitute the electric outfit and save money. Contracts were entered into and they proceeded at once to wire their premises, after having made arrangements with the Commission for delivery of the 20-horse-power outfit for the early part of August, so as to be able to thresh from the field if possible. Similar outfits multiplied rapidly throughout the province within the next two or three years.

The Canadian township could arrange to operate its own system, but usually it was found that the municipality from whose station the power was supplied could operate the system much more cheaply. This arrangement was made by first getting the consent of the Commission and then passing the necessary resolutions by the Council or local Hydro Commission. When arrangements were made to have some other municipality operate the system, they would collect all power bills from customers and pay all expense in connection with the operation of the system. They would also pay the Commission for power required to supply the customers and they would pay to the Township Council the annual fixed charges on the hydro debentures, and pay to the Commission for the township the annual fixed charges on the investment for the primary lines.

Originally for the farmer, the rates to the consumer included all the above charges. The rural rates were made up of two separate charges; a flat service charge varying inversely as the number of consumers per mile, and a consumption rate per kilowatt hour. The least amount of power that could be contracted for was one horse-power, so that a customer having a 2-wire, single-phase, 110-volt lighting service, would have a one-

horse-power contract. A large percentage of the consumers wish a three-phase, 110-volt power service so that they could install a 5-horse-power motor.

In 1919 the cost of construction on the farm was higher than heretofore on account of increased cost of labor and materials. Assuming that the farmer's barn is 600 feet from the pole line on the road and the house 300 feet distant from the road, the transformers could probably be located close to the barns as that is where the greatest amount of power is used, and secondary wires would be carried back to the house. With this arrangement the cost was not excessive to connect up the buildings to give three-phase service to the barn and single-phase service to the house. The cost of wiring where wires are concealed and the work is what is known as "knob and tube work" was formerly about $2.50 per outlet, but is now somewhat higher. For former conduit work, that is, wires in piping, the cost has increased from $3.50 to $5.00 per outlet.

A typical installation was utilized on a farm in West Oxford. This owner belted to a line shaft a milling machine and a cutting box, with a carrier that was used during the time that he was filling silo and disconnected for the balance of the year and used for cutting hay or straw. He uses a threshing machine with which he threshes all of his own grain, using only his own help. This machine is rated by the manufacturer at 60 bushels of oats per hour. He has a pump, a milking machine and an emery-stone and grind-stone. All of the buildings, of course, are electrically lighted. In the house is used an electric iron, a washing machine, a 2-burner hot plate and an electric oven. This farm was taken as typical because it was a moderate size—approximately ninety acres. The owner used his power advantageously and the total cost to him was $96.00 per year.

Not only on the farms of Canada, but in the cities, cheap Niagara power has produced wonderful savings to the people. The Toronto hydro-electric system is undoubtedly conferring great benefits and advantages upon the power and light consumers of the city. The officers of the system have computed that reduced rates for residential and commercial light and for commercial power that have been instituted and maintained during the seven years ended 31st December, 1918, have resulted in a net saving to its customers in these services as compared with the former prevailing rates of approximately $12,500,000. This sum in itself is much greater than the total capital invested in the enterprise by the city, and by the Provincial Commission on behalf of the city in right-of-way, tower lines and transformer stations. As a consequence of its competition there has also been an all-round reduction of rates for similar services rendered within the city by its commercial competitor. At the same time the quality of the service rendered by all has, under the stimulus of competition, greatly improved when compared with the pre-existing standard. In view of the acute coal shortage during the latter years of the war it is interesting to note that the power sold by the system in the city of Toronto for commercial purposes during these three years would have required for its generation by steam under favorable conditions approximately 400,000 tons of coal. It is obvious that had the system's supply not been available the hardships resulting from the scarcity of fuel for domestic use would, on the one hand, have been greatly aggravated by the insistent competition for coal to generate power for the manufacture of munitions, while on the other hand there can be no question that under such circumstances the output of munitions from the city of Toronto would of necessity have been much less than was the case.

Wonderful Clocks of Olden Times

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days. Each calendar indicates the number of days of the month, the days of the month, and the days of the week, the principal Saints' days and the Ecclesiastical feasts. This clock, in fact, gives a whole lot of astronomical information, telling also the days when the sun enters a new constellation. A staff, held by a figure placed on the right, above the dial, points to the day of the month. The other dial on the right of this calendar dial gives the altitude of the sun. The inner disk of this dial is set in motion by a pin and is designed to regulate the greatest length of the days from 12 to 17 hours. Consequently, by means of this mechanism, one can make calculations for different latitudes. The small dial just below this to the right is not operated at all by the clock mechanism. The hand must be set on the dominical letter of the present year.

The modern hanging clock certainly looks very simple compared with the complicated hanging clock shown separately, built three hundred years ago. In reality the clock looks very much like a large watch. It has a large silver dial, richly enameled. On the outer edge of the dial is a perpetual calendar. There are also given the signs of the Zodiac, the days of the month, and in regular order toward the center of the clock the phases of the moon, the hours and the days of the week. All these things are indicated by different hands. The clock is suspended from an ornate ring, and has a diameter of 13½ inches.

Handling Ore on the Docks

ONE of the big mechanical features of present-day conditions is the unloading of bulk cargoes from cars and ships; and great are the economies which have been effected in this kind of work since the days when it was done by men with wheelbarrows and shovels. The scope for the engineer's ingenuity is especially great at a point where the material in question—coal, grain, ore, or what not—is transferred without really breaking bulk. Thus, for instance, we have the enormous pieces of machinery that give a continuous movement of the material out of the hold of a ship and into a string of cars, or vice versa.

A scheme frequently employed in such transfers, when the object is solely the unloading from cars and the loading upon ships, is to pick the cars up bodily and empty them into the hold of the ship through a chute, much as one would empty a wheelbarrow. This method, of course, is applicable only for coal or some such commodity that can be carried in unroofed cars. It is also applicable, as just suggested, only where the direction of the stream of traffic is never reversed. One could hardly load coal from ship to car by picking the car up and turning it over, as is done by the machinery that has been described in other issues of the SCIENTIFIC AMERICAN.

But where it is necessary to reverse the flow of traffic, or at least to provide that it shall be reversible, the mechanical engineer is by no means at a loss. Our cover this week illustrates a huge ore-handling outfit, one of whose advantages is that it can load either from cars to ship or from ship to car. The giant grab-buckets descend into the bowels of the ship or into the bottom of the open ore-cars, emerging with a full load; and this, under the complete control of the man behind the switchboard, they deposit in the desired place on train or boat. Operating costs are of course a bit higher than when the entire contents of a great gondola can be spilled out at one sweep; but they are far from reaching an alarming figure withal.

Latest Patent Decisions

(Continued from page 96)

and committed under circumstances calculated to arouse just apprehension that it would be persisted in, the remedy is to be found in equity and in an injunction.—*Miller Rubber Co. v. DeLaski & Thropp Circular Woven Tire Co. U. S. C. C. A. of Ohio.*

What Not to Invent:—The invention in the patented device involved in this suit relates to a heating stove adapted to be placed in tanks of water for the purpose of warming their contents and being particularly useful for warming the supply of drinking water provided for live stock. Action was for infringement of patent issued to Nels M. Nelson. This claim was held invalid and the bill was dismissed for want of equity. Nelson appeals. Held, that the Nelson patent is void for lack of invention. The conclusion is compelled that Nelson has not taken even the short advance step which constitutes patentable invention. The field was crowded when he entered it.—*Nelson v. Lloyd Mfg. Co. U. S. C. C. A. of Mich.*

Lack of Invention:—The patented structure indicated in the claim herein, contemplates a building construction, comprising perforate metallic lathing and a stud of malleable metal with flat prongs formed thereon and therefrom by making perforations in the flat portion of the metal strip so that the prongs are supported at one end and have metal on each side of them, projecting through perforations in the lathing and bent over the latter so as to clinch same. Sheet metal supports in the form of studding had been used to carry perforate metal lathing long before this invention of Caldwell's. The two had been fastened together by separate wire fastenings. Also, it was common to attach things to be carried by sheet metal support to that support by cutting out and striking up a prong from the support and then bending it back over the part carried. One of the older instances of such use of this attachment was to make the fastening between a tubular sheet metal fence post and the supported fence wire. To use this method of fastening to carry one or two strands of the metal lathing, instead of to carry one fence wire, cannot be considered to involve invention. The principles involved are so familiar that there can be no invention allowed.—*Berger Mfg. Co. v. Trussed Steel Concrete Co. U. S. C. C. A. of Ohio.*

No Injunction on Doubtful Grounds.—This is a suit by the Esta Co. against Alfred W. Burke, trading as the Automobile Devices Co., on motion for preliminary injunction. Denied. The bill sets up that the plaintiff is the owner, through assignment, of a patent issued to Esten Beeler upon an application for improvements in bubble-making machines. The object of the invention is to produce bubbles in large quantities of a very dry nature in any size desired for display and theatrical illusions or other purposes. The single claim is for the combination in a bubble-making machine of a tank or suitable container having a false bottom with a plurality of small holes therein, means for introducing compressed air beneath said false bottom, and a solution of bubble-making properties maintained above such false bottom. The plaintiff has used the invention embodied in the letters patent in a device for humidifying the air supply to internal combustion engine. The plaintiff is also the owner of a trade-mark for humidifiers for internal combustion engine. In connection with the ruling above mentioned by this court, the point of law is made that a preliminary injunction will not be granted in a suit for infringement of patent or trade-mark where both validity and infringement are doubtful—and jurisdiction of a suit for unfair competition is not conferred upon a Federal court by joining with it a separate cause of action for infringement of a patent or trade-mark.—*Esta Co. v. Burke. U. S. D. C. of Penna.*